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OFFICIAL PROCEEDINGS

Central Railway Club

Vol. 9 January Meeting, 1903 No. 1

PUBLISHED BY THE CLUB

Entered as second-class matter at the New York, N. Y., Post Office, February 21, 1899.

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..OF THE.

CENTRAL RAILWAY CLUB

VOL. 9. NO. 1. NEW YORK, January 9, 1903 { $1.00 PER YEAR 25 CENTS A COPY.

REGULAR MEETINGS AT BUFFALO: SECOND FRIDAY IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER, AT 2 P. M.

PUBLISHED IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER at No. 62 LIBERTY STREET, NEW YORK.

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L. R. POMEROY, Spl. Rep., R. R. Dept. Gen. Electric Co., New York.

NEXT MEETING, Friday, March 13, 1903, at 2 P. M.

THE JANUARY MEETING

HOTEL IROQUOIS,
BUFFALO, N. Y., January 9, 1903.

The annual meeting of the Central Railway Club was held at the Hotel Iroquois, Friday, January 9, 1903, at 2 P. M., Vice-President Barhydt occupying the chair. The members registered in attendance included the following:

Thomas Aldcorn,	S. H. Jones,	E. A. Phillips,
F. D. Adams,	W. F. Jones,	A. C. Robson,
Thomas Anderson,	E. Kopperman,	W. H. Rosevear, Jr.
J. G. Blunt,	J. G. Kiel,	T. Rhodes,
A. B. Brown.	G. F. Knaus,	J. W. Sheldon,
Henry A. Boyd.	J. D. Murray,	C. A. Sherman,
H. M. Butts,	R. F. McKenna,	Charles Shults,
H. S. Bradfield,	E. P. Mooney,	W. H. Sanford,
D. M. Brady,	H. C. McCarty,	C. L. Snyder,
W. T. Burton,	E. A. Miller,	Eliot Sumner,
David Brown,	James Macbeth,	C. E. Turner,
C. T. Chapin,	James A. Mellon,	Thomas Treleaven,
Charles D. Golz,	A. V. Newton,	William Tunkey,
Carl R. Green,	A. B. Niel,	W. O. Thompson,
Arthur Gemunder,	E. C. Neal,	B. M. Tate,
W. L. Holman,	William Ogilvie,	W. C. Turner,
Cornell S. Hawley,	H. H. Perkins,	George W. West,
H. H. Hewitt,	L. R. Pomeroy,	F. W. Williams.
Frederick Johnson,	R. H. Parks,	

THE VICE-PRESIDENT:—The meeting will please come to order. The first order of business will be the announcement of new members.

NEW MEMBERS.

THE SECRETARY:—We probably have the largest list of new members that has been presented at an annual meeting in some time, a number of them being the result of the change in the Constitution that broadened the eligibility for membership. The applications are as follows:

Calvin Youmans, G. F., N. Y. C. & H. R. R. R., Oswego, N. Y.

F. W. Williams, D. M. M., D. L. & W. R. R., East Buffalo, N. Y.

C. L. Snyder, C. C., M. P. Dept., Penn. R. R., Buffalo, N. Y.

Charles W. Edgerton, Loco. Eng., N. Y. C. & H. R. R. R., Buffalo, N. Y.

Bertram Cole, Loco. Eng., N. Y. C. & H. R. R. R., Buffalo, N. Y.

Frederick C. Ganson, Loco. Eng., Erie R. R., Buffalo, N. Y.

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A. V. Newton, Passenger Conductor, L. S & M. S. R. R., Buffalo, N. Y.

Wilbur L. Pierce, B. M. Jones & Co., Boston, Mass.

R. C. Fraser, U. S. Metal & Mfg. Co., New York.

W. E. V. Kemp., C. C., D. L. & W. R. R. Machine Shops, Buffalo, N. Y.

Carlos O'Connor, G. Storekeeper, D. L. & W. R. R., Scranton, Pa.

James A. Mellon, Chf. D., D. L. & W. R. R.. Scranton, Pa.

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W. O. Thompson, D. S. M. P., R. W. & O. R. R., Oswego, N. Y.

David A. Campbell, Columbia Refining Co., New York.

S. B. Keys, Consolidated Car Heating Co., New York.

THE VICE-PRESIDENT:—What is the pleasure of the Club in reference to these applications ?

THE SECRETARY:—The applications have been made in regular order and passed upon by the Executive Committee, Mr. President, and no special action is needed beyond reporting them. Resignations have been received from R. Sloggett, Isaac Bond, James B. Martin, John Mostberger and Samuel King.

REPORT OF THE EXECUTIVE COMMITTEE.

THE VICE-PRESIDENT:—No further business being offered under that head, we will open under Reports of Standing Committees.

THE SECRETARY:—The Executive Committoe report that notice was received of the death of J. O'Connor, who was connected with the Lackawanna Railroad as General Storekeeper; also of G. M. Davis, who was General Car Inspector of the Pennsylvania.

Vice-President Willard, of the Erie, who it was hoped would be able to give the Club a paper at this meeting or some future meeting, finds his engagements are such that he cannot accept the invitation.

When it became necessary to arrange a paper for this meeting, Mr. West suggested that the matter of steam indicators was of more

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than ordinary interest and quite a number of mechanical men had mentioned to him the necessity of more information on this important subject. In accordance with a further suggestion it was taken up with the Crosby Steam Gauge people. They replied that a change in their general superintendent made it impracticable for them to help us out for at least a year. In following out the matter the Secretary had some correspondence with Prof. F. R. Hutton, of the department of mechanical engineering, Columbia University. and he kindly suggested Mr. Charles E. Lucke, doctor of philosophy and an instructor in that department. No time was lost in communicating with Dr. Lucke, and the Secretary is happy to say the invitation of the Club was accepted. After spending a good deal of time and labor upon the matter Dr. Lucke has produced a paper which is in your hands. He has an elaborate array of apparatus with which to illustrate his points and is himself here in person prepared to interest and entertain you with what undoubtedly will prove one of the best papers the Club has ever had.

A communication was received from the Pacific Coast Railroad Club, after our last meeting offering prizes of $100, $75, $50 and $25 for papers pertaining to the construction, equipping, maintaining and management of steam railways. The time limit appointed for this competition was January 1 of this year. The Secretary of the Pacific Coast Club was advised that the time would not permit of its presentation to this Club as we would not meet until January 9th, and a later communication from him states that the time has been extended to February 1.

A communication has been received from the Car Foremen's Association of Toledo, asking for the interpretation of a certain rule, and the Executive Committee decided to lay it over until the next meeting. The letter is as follows :

THE CAR FOREMANS' ASSOCIATION OF TOLEDO, OHIO,
TOLEDO, Ohio, November 30th, 1902.

Mr. H. D. Vought, Secretary The Central Railway Club.

DEAR SIR :—Referring to Rule No. 28 of the revised M. C. B. rules of interchange which went into effect September 1st, 1902 :

This rule reads: "Journal bearings and journal box bolts which require renewal by reason of change of wheels or axles for which

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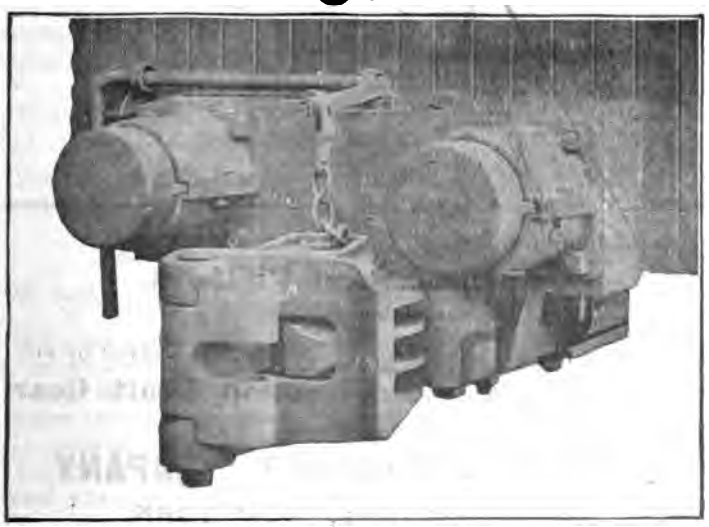

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show that it is sound to the core, while the exceptional character and able treatment of subjects taken up from time to time serve to clearly indicate that a progressive spirit is still dominant in its affairs. Keeping in mind the limitations for growth, which have always more or less conspicuously handicapped strenuous efforts to build up the organization beyond any position it has occupied, it will be appreciated that the record is in all respects both commendable and gratifying. In view of the greater scope and opportunity afforded sister clubs to steadily increase and broaden, the Central Club may reasonably insist that its comparative standing upon the basis mentioned is equally as high, its influence as strong and its work as far reaching, significant and beneficial. It has more money in bank to-day than at any time in its history. Difficulties and obstacles have been experienced in producing this result. The task has been burdensome, owing to increasing combinations of great industries that, in common with other railroad clubs, the Central is of necessity dependent upon for its chief source of legitimate revenue. Embarassments in this regard steadily multiply with each recurring year and seem likely to continue doing so. This fact should be a matter of thoughtful remembrance. Tact and zeal, however, have so far made it possible to overcome effects threatened by unavoidable losses of business. So the Club is still kept well supplied with the sinews of war for the successful prosecution of its work. In short, the Club is very much alive and gives promise, under an outlook now fraught with unbounded encouragement for the future, to have a realization of what its best friends have unselfishly sought to promote.

There is still occasion for personal diligence and individual interest in an effort to increase the membership. Its enlargement is almost entirely dependent upon intense appreciation of this by those already enrolled upon its roster. Careful study of what is being done in this direction by other railroad clubs, and especially the juniors in the list who have attained such lusty strength, will quickly reveal that the secret of their success in this particular lies nearly altogether in personal activity. With the doors now wide open to all classes of employes in every branch of service, it needs but the cordial personal invitation of members, supplementing that of the Club as a whole, to enter and partake of the Club's offerings, to induce many to associate themselves with you who might otherwise never give the matter more than a passing thought. Another year, through such solicitation, should show fewer losses, less retrogression in this one feature and a greater accession of new material and young blood than has ever been known.

Some radical changes have been made in the Constitution and By-laws relative to eligibility for membership, methods for the nomination and election of officers, etc., that have effected more elasticity and greater opportunity. To the authors of these innovations they

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seemed calculated to inspire greater interest in the organization, in the elimination of features that had prompted adverse criticism, to bring into activity desirable elements, to insure greater harmony of operation, and to attract to both the membership and the meetings of the Club a much greater number of those whom it is deemed essential shall improve and advance in the mechanical branches of railroad service.

In the matter of individual papers perhaps not as much has been accomplished as is needed to still further advance the standing of the Club and the quality of its Proceedings; but still there has been a measure of gratifying progression. It takes time and patient industrious effort to gain needed recognition from the outside world in the development of a new policy for the attainment of practical benefits. There is no reason why much more should not be achieved in the future. It will be if the matter is taken hold of in the right spirit and with the proper determination. It has been shown that men of recognized authority as experts and instructors, who are engaged in the solution of big problems, can be induced when rightly approached to give you the benefit of their study, thought and experience. It is especially demonstrated to-day in the presence at your annual meeting of an instructor in the specialized department of a great University, and to whom the Club is deeply indebted for the exhaustive preparation required for the intelligent handling of the subject with which he is to deal. It is no small honor and favor that is thus conferred.

The year 1902 was begun with an active membership of 292, of whom 58 were in arrears. In the succeeding 12 months 27 were suspended for nonpayment of dues, 11 resigned, including those whose resignations have been reported to-day, and three died—Peter E. Garrison, Master Mechanic of the Fonda, Johnstown & Gloversville; Charles O'Connor, General Storekeeper of the Delaware, Lackawanna & Western, and G. M. Davis, General Car Inspector of the Pennsylvania. The total number of new members elected was 25, so that our active list now numbers 277, exclusive of the applications received to-day. We have 38 members liable to suspension, though in the light of past experience it is safe to assume that a goodly number of these will liquidate.

The new arrangement for the interchange of Proceedings with other clubs has not commanded much consideration, only three members having so far subscribed the necessary fee to entitle them to receive these publications.

The financial statement for the year follows, and would show a greater cash balance if all unpaid bills had been settled. The Club had no unsettled obligations at the close of the year:

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FINANCIAL STATEMENT.

Cash on hand at the close of the year ended Jan., 10, 1902 . .		$926.72
Receipts.		
From advertising	$1,472.00	
" dues	520.00	
" sister clubs	278.23	
" bank interest	15.31	2,285.54
Total receipts . . .		$3,212.26
Disbursements.		
For printing	553.79	
" stenographer	150.00	
" Secretary's salary . . .	500.00	
" postage	114.35	
" reports of sister clubs . . .	325.91	
" Club entertainment . . .	123.00	
" Secretary's expenses at Saratoga	50.00	
" bank exchange	2.70	
" refund to Secretary . . .	2.74	
" Secretary's bond . . .	7.50	
" cuts	37.52	1,867.51
Balance on hand Jan. 9, 1903		$1,344.75

I suppose, in this connection, in order to preserve the continuity, that properly the report of the Auditing Committee appointed by President Petrie early last year to make an examination of the books of the Secretary-Treasurer would now be in order.

MR. MOONEY :—I move the report of the Secretary be received and filed.

MR. WEST :—I second the motion. Carried.

THE VICE-PRESIDENT :—Has the Auditing Committee its report?

MR. JONES :—Mr. West and myself went over the accounts and found them to be correct as presented by Mr. Vought.

THE VICE-PRESIDENT :—Is there anything else under that head ?

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THE SECRETARY :—I think that is all of the routine business, Mr. President. Unfinished business is next.

THE VICE-PRESIDENT :—We will take up unfinished business and continue the discussion of Mr. Pomeroy's paper, delivered at our last meeting.

FURTHER DISCUSSION OF MR. POMEROY'S PAPER.

MR. POMEROY :—Knowing full well the value of this paper of Dr. Lucke that is to follow, I will occupy just as little of your time as possible.

In opening the discussion I desire to utilize the opportunity to amplify or restate some of the points mentioned, for the purpose of emphasizing and bringing out more clearly certain items that have an important bearing on the general subject.

* "Apropos the question of variable speed, either by mechanical or electrical means, it is reasonable to presume that the solution of a problem that has proven so difficult mechanically may involve electrical difficulties as well. Although electrical apparatus may be provided which will accomplish the desired purpose, yet this may be at the expense of added complication, additional apparatus or increased cost. It is not, therefore, proper to decide a priori that, because speed variation can be effected by an electric motor, the variable speed motor should always be used regardless of conditions, requirements or cost.

"In selecting the apparatus for a new plant it is proper to consider the problem as a whole, to take a general view before concentrating attention upon specific parts; what proportion of the power is to be supplied at constant speed? What proportion of the variable speed work cannot be served satisfactorily from a constant speed drive with variable pully ratios or variable gear ratios? What proportion of the work that requires delicate speed adjustment falls within the range of simple and satisfactory speed-changing devices? What advantage in lessened cost of equipment will be secured by group driving, but furnishing a single large motor for delivering the average power required by a number of machines instead of a large number of small motors each for delivering the maximum power of the machine to which it is connected. What advantage will there be under the particular surroundings of the installation in reducing the complication and the amount of auxiliary apparatus and putting in motors of the

* Proceedings Am. Ins. Elec. Engs.

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simplest possible type? Taking the plant as a whole, what are the general advantages of one type of apparatus over another, and does the general balance sheet show that the advantages of individual speed control by means of the motors themselves are of sufficient moment to dictate the whole scheme and plan for the whole installation? The varying answers which will be given to these questions in different cases will necessitate different solutions to the problem of selecting the best system."

Professor D. C. Jackson summed up the situation in regard to machine tool driving by individual motors as against the grouping system by saying that the selection of an electric shop equipment was a *matter of engineering common sense.* If there was a lot of miscellaneous tools operating intermittently, the sensible thing to do was to group them into sections on line shafts, these sections to be driven by motors. In this way the investment in motors would be kept down, and the line shaft losses would not be excessive. On the other hand, for large tools in a manufacturing establishment, direct driving, with provisions for varying the speed to suit exactly the work to be performed on a machine, was the most economical, because of the greater output obtained from the machine tools.

* "In connection with the subject of variable speed motors it should be noted that it takes practically a constant horse-power to remove a given amount of metal per minute, irrespective of the rotative speed of the tool. Therefore, the main spindle of the lathe taking a three-eighths inch cut on a six-inch steel shaft with a feed of one-eighth inch and a cutting speed of fifty feet per minute makes thirty-two revolutions per minute, and takes a certain horse power to drive which we will assume to be fifteen horse-power, and the motor will be working on its highest potential, or 250 volts. Now, if we are using the multi-voltage system with the last named potentials above, and should put a forty-eight inch wheel in the same lathe and turn up its rim with the same cut, feed and cutting speed, the main spindle would run at about four revolutions per minute or one-eighth of the previous speed, but still require fifteen horse-power to drive. With this condition the driving motor would have to run on its lowest potential, or forty volts, and would be consuming fully six times the amount of current it did previously. You will therefore see that a motor to be used on the multi-voltage system will have to be sufficiently large to carry its maximum horse power at the minimum potential, or, in other words, at, say, forty volts on a 250 voltage system the motor will have to be six times too large when working on its

* Proceedings Am. Inst. Elec. Eng.

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maximum potential. For this reason I feel that we must keep the lowest potential employed as high as possible in order that the size and cost of the motor may be within reasonable limits. A potential of forty or sixty volts requires such large conductors, if they are laid out for a small drop, that their cost is prohibitive in a plant of any size. If a large drop is used the motor falls off in speed under load, and its speed regulation under changes of load is little better than with the rheostatic control."

The question of increasing the amount of work per man per tool is one that is co-relative to electric shop driving, and the introduction of tool steel capable of working at high cutting speeds, made possible by electric driving, brought out the fact that lathes which we were using and which had been considered abundantly strong and powerful, were incapable of utilizing the new steels to their full advantage. Increasing the belt speeds did not secure the desired results, demonstrating that the machines designed for cutting speeds of from 25 to 30 feet per minute could not be expected to work at cutting speeds of from 75 to 100 feet per minute, particularly if the amount of feed and depth of cut were to be retained.

Cutting speeds of from 100 to 150 feet per minute, now made possible by some of the tools recently brought out, would effect a saving of from one-fifth to one-tenth of the former cost.

As an illustration of this, the writer calibrated the work being done with a so-called "rapid-reduction lathe," turning a 9-inch forged steel shaft, with the following result: Cutting speed, 125 feet per minute with one-half inch cut and a one-twelfth inch feed, or the equivalent of 62½ cubic inches, or 17½ lbs. of metal removed per minute.

This was not a special test, but the regular duty of the machine, and the data was taken without previous arrangement with the workman at the lathe. The machine was operating with two tools, one on either side of the work. The ordinary double head axle lathe, cutting at the rate of 30 feet per minute, requires, ordinarily, a 5 horse-power motor; this tool, with a cutting speed of, say, four times as much, requires a 20 horse-power motor, so that it would seem that there is a definite relation between the cutting speed and the power to drive the tool.

Interesting data concerning a Lodge & Shipley reducing lathe has been furnished, namely, with three cutting tools the aggregate depth

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of cut was three inches, with 1-16 inch feed and speed of 50 feet per minute. The material was 50 carbon steel. The amount of metal removed per minute was 113 cubic inches, or 31.64 lbs. power to drive 50 horse-power.

Bearing directly on this point some shop notes in the December *American Engineer* are worthy of note :

"In a certain shop a new high grade of tool steel was recently tried on a 58-inch Latrobe tire 5½ inches wide. The machine was a new 84-inch Niles lathe, and the tool finished the tire without grinding, the cut being one-half inch deep and the feed one-sixteenth inch, at a speed of 31 feet 4 inches per minute." (Removing 11.75 cubic inches, or 3.25 lbs. metal per minute.) "With ordinary tool steel a 56 inch tire was turned 11 feet per minute, the cut being one-half inch deep by one-thirty-second of an inch feed." (Removing metal at the rate of 1.98 cubic inches or 0.55 lbs. per minute.) "This tool required grinding after a cutting distance of two inches across the tire. At this point the tool of special steel was again put in at a one-half inch cut by one-eighth inch feed, at 31 feet 4 inches per minute (or an equivalent of 23.5 cubic inches or 6.60 lbs. of metal per minute.) This speed proved to be beyond the capacity of the lathe."

This brings up the point that in selecting the proper capacity of motor for a given tool or group it is quite necessary to know the full possibilities as to depth of cut, feed and speed in feed per minute of the tool itself.

"In the same shop a test was made with the same steel in a boring mill. The tire was bored at a speed of 27 feet per minute, the cut being ¼ inch and the feed 3-32 inch. A tool of ordinary self-hardening steel took a 5-16 inch cut with a 1-32 inch feed at a speed of 12 feet per minute, the tool giving out after cutting 1¼ inches across the tire. Six and seven hours were required for boring a pair of tires with ordinary steel, as against four hours for a pair of the same size with special tool steel. Less time would be required with the new steel if the machine was rigid enough to stand up to the work.

"In still another shop the line shafting has been speeded up 21 per cent. since last year. Planers for general work are driven at 28 feet per minute, the shafting for the group-driven machines running at 170 revolutions per minute. In this shop 33 inch coach wheels are turned in an old lathe at the rate of three pairs per day. When ⅝ inches of material is to come off the first cut is ¼ inch and ¼ inch feed at 35 feet per minute, and the finishing cut is ⅛ inch with ¼ inch feed and the speed 40 feet per minute.

"On the boring mill the time for boring out a 79 inch tire was

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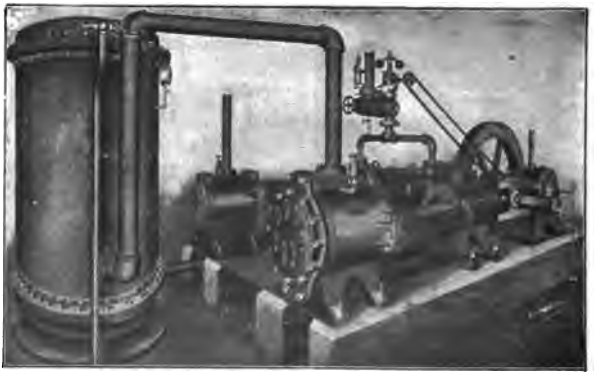

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stated to be one hour, the cut and feed being 1-8 inch and the speed 57 feet per minute. This time is said to include that for setting the tire in the machine.

"In the wheel lathe tires are turned at 35 feet per minute with 1-4 inch cut and 1-4 inch feed.

"In another shop a record of 50 pounds of steel per tire per hour was reported for a wheel lathe and one of the new brands of tool steel.

"These records were taken from verbal statements They represent wide differences in practice, but they serve to reflect increased attention to the commercial aspect of railroad shop practice, and they indicate the advantages of motor driving."

In closing it might be well to call attention to the fact that "electric apparatus not only replaces that which it supersedes and gives more efficient service, but also leads to developments which were impossible by former methods. Thus the incandescent lamp has not only replaced old methods of illumination, but created an entirely new field. The same is true of the application of electric motors, particularly in regard to railway work and shop driving.

"The use of electric cranes in factory work, for handling heavy materials and tools, has done more to bring about progress in shop methods than any other single factor."

THE VICE-PRESIDENT:—Does any member desire to question Mr. Pomeroy relative to this subject or to discuss it further?

MR. MOONEY:—I would like to ask Mr. Pomeroy what grade of tool steel was used in this last case?

MR. POMEROY:—I don't know; the tool steel used in the test mentioned, where a cutting speed of 125 feet per minute was obtained, was "made in the United States."

MR. WEST:—Mr. President, I have a letter in my possession from Mr. Lloyd, of the D. L. & W., saying that he was going to send some representatives here to talk on this subject, and I think we would all be interested in hearing from them. I think Mr. David Brown and Mr. Mellon are prepared to give us their views on the subject.

MR. BROWN:—Mr. President, I think that is a misunderstanding. We have not had any experience in the way of electricity for driving shop machinery and of course you can expect us to know but very

little about it. We came here to hear this discussion, hoping to be better informed by hearing it discussed by members who had already used that power. There is no doubt that we will have to come to it. Electricity is the future power that we have got to look to; does away with a great deal of our trouble, we can have better light in shops, haven't got the belts and shafting to bother with, and being able to run certain portions of the machinery independently of the other, which is very convenient when required, and, furthermore, according to the statements that Mr. Pomeroy has given us, he achieved speed and cuts that we could not possibly get at with present methods. I will state that we have very little to say about it, for my part just coming here to hear the discussion rather than to say anything about it, for the reason that we have not had the experience necessary to discuss it intelligently. Probably some of the other gentlemen present who accompanied us may wish to ask for some information.

THE VICE-PRESIDENT:—It looks very much to me as though modern tools would have to keep pace with modern driving appliances, considering examples of the kind described by Mr. Pomeroy. Is there any further discussion of this subject?

MR. J. D. MURRAY:—I would like to ask Mr. Pomeroy a question or two on this subject. From listening to the reading of this paper just now, he has taken up the question of cutting tools, and it has all been, as I understood it, with reference to metal work. Having looked into this subject a little, although I am not an electrical engineer, I understand that the direct current motors can be handled much better by varying the speeds, with controllers, etc. You can change the speeds of the direct current motors and handle your work at the machine without shifting the belts. But I would like to ask him a question or two with regard to wood-working machinery. The D. L. & W. are contemplating building new shops for car work only and the most of our machinery will be wood-working machinery; the car work does not require so much machine work as the locomotive. With a large mill, to do all the work for the road, we will have quite a lot of wood-working machinery in the mill, and I understand that the alternating-current motors give a constant speed and we would have no trouble with sparking of the com-

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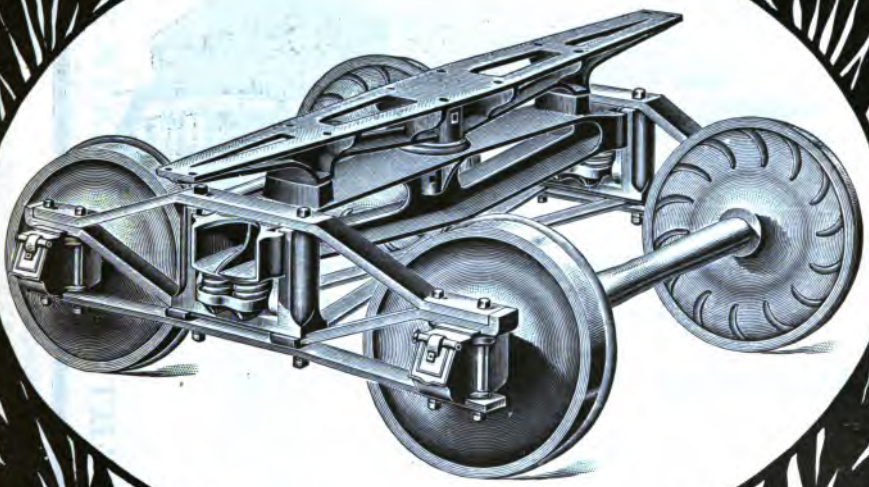

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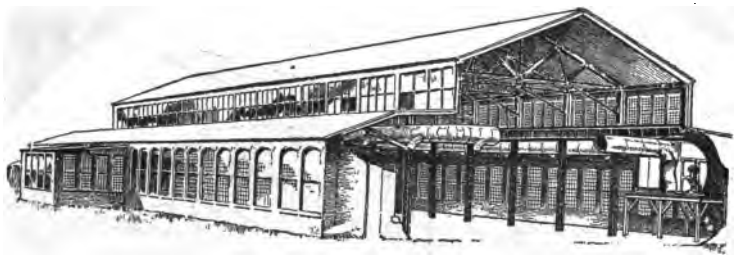

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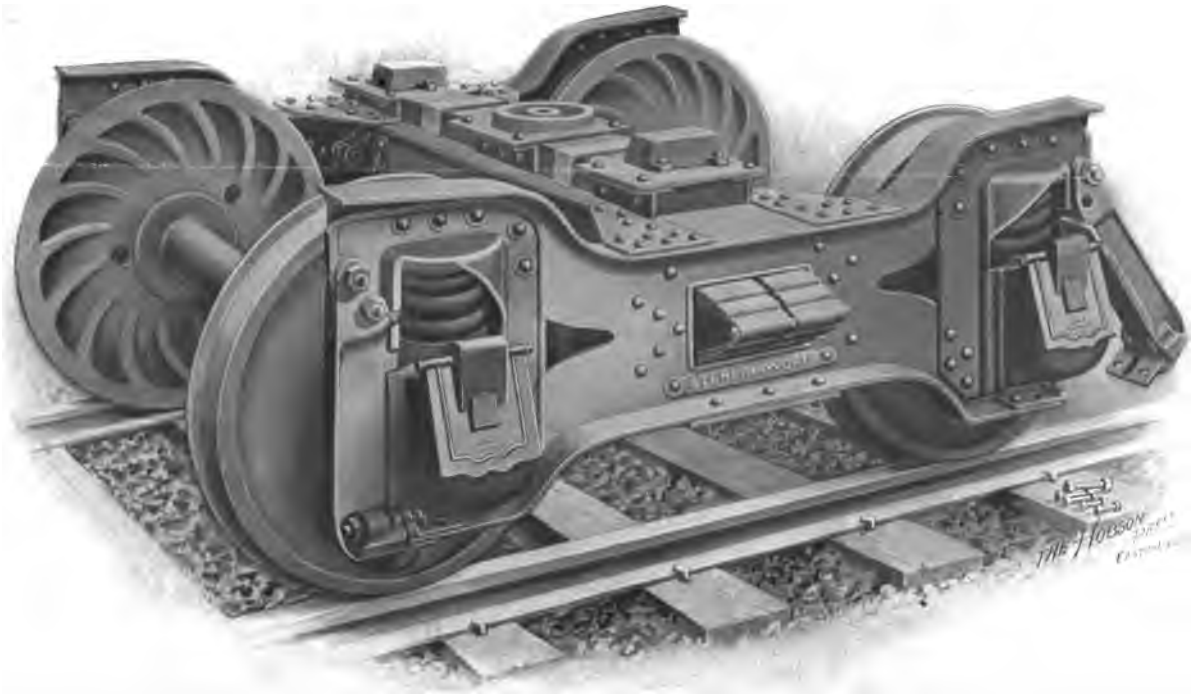

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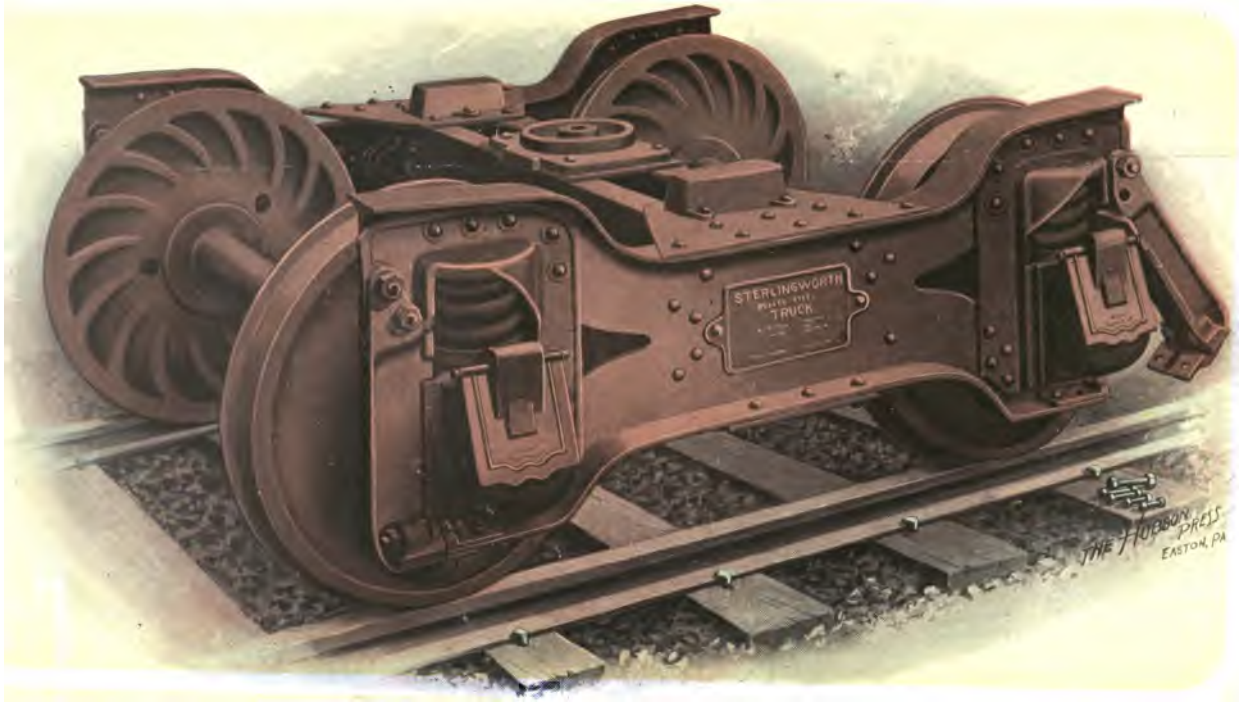

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mutators or turning down some, and from what I have learned I believe that they would be best adapted to wood-working machinery, such as the sill-dresser, large planers, cross-cut and rip-saws, etc. In the blacksmith shop, where we use large sheers and such tools, my understanding is that it would be the same there, and in the machine shop, where we want variable speeds on lathes, etc., why, that the other is best. But I would like to ask him in connection with this special plant, if in deciding on the different kind of motor and current to use, with the larger proportion of the work done in the mill and in the blacksmith shop combined, would it be best to use the alternating current throughout or the direct current? Of course, the alternating current could be used in the machine shop on a number of tools, but on some of them it would be more desirable to have variable speeds.

MR. POMEROY:—Practically all the requirements in a wood-working or smith shop can be met by a constant speed motor, therefore the induction motor is particularly well suited for this class of work. The absence of commutator and brushes and other inherent advantages possessed by the induction motor naturally differentiates this type of motor from others for use in shops where dust and dirt is so prominent. This is accentuated where such dust is of a more or less explosive or inflammable character. I am informed that the insurance underwriters take these facts into consideration in rating shops equipped with electric drives by making the rate lower where the shop is driven by induction motors.

In cases where the fire risk is not increased by the character of the dust and floating particles, the wear and tear and consequent repairs and renewals due to the presence of grit in connection with the rubbing surfaces or contacts, *i.e.*, commutator and brushes, is entirely eliminated by the use of induction motors.

Doubtless the time is coming when the induction motor will entirely replace the direct current motor, but, at the present state of the art, wherever variable speed is required it can be obtained much more advantageously by direct current machines, although the A. C. motor is being successfully used in certain classes of variable speed work, and its use is on the increase as the state of the art is advanced.

Inasmuch as by far the largest power requirements can be met by constant speed motors, and as the variable speed requirements in a railroad shop are comparatively small, as referred to in the paper, it would seem a sensible compromise would be to lay out the shop primarily on an alternating current basis; as all the advantages of the appropriate use of A. C. apparatus, economy of transmission of power and lighting to distant and remote points, etc., can be realized. And by transforming, either by means of a rotary converter or motor generator, sufficient power to handle all the variable speed requirements. This need not complicate the wiring system, as the transforming apparatus can be placed in the shop adjacent to the variable speed tools, and, consequently, not affect the main wiring or conduits, as the only additional wiring would be between the tools and converting apparatus.

Advantage can be taken of the opportunity of taking out a neutral or third wire from either the rotary converter or motor generator that will provide a practical three-wire system, void of complications, and simple and direct in application. This method gives the means of procuring a speed range of 4 to 1 if it is desirable to use a greater range than 2 to 1, as obtained by a two-wire system previously described. No hard and fast rule can be laid down, however, as the varying conditions and modifications necessarily require each case to be studied by itself and a scheme appropriate to the special case devised.

MR. MURRAY:—I would like to ask another question if I may—

MR. POMEROY:—Did I cover all the other points of your question, Mr. Murray?

MR. MURRAY.—Yes, sir; very thoroughly. I have read a number of articles and had a number of talks with different gentlemen and I find that some advocate grouping the machines and using one motor for a number of machines on a short main shaft; on the other hand, some advocate an individual motor for every machine, and we had some of the electrical people there last fall and I find that they are inclined to advocate the individual driven machine; that is, a motor for every machine. With the shop the Lackawanna contemplates building, of course they use a lot of their old machines and it would be quite an expense, I imagine, to

arrange the details to drive each machine separately, and I really, so far as I can see, do not believe it is the best policy to individually drive every machine. I think it is probably better to group a few. Then I might also state that we have about ten or fifteen motors in our shop now running and we find that there is more or less sparking, and every once in a while we have to take a motor out and turn down the commutator. We have only had machines for about a year and a half since we got the first one, but if that continues very long I imagine we will have to get a new armature altogether to replace that part of the machine, and with the alternating current that is not necessary at all. I understand that the alternating current is more expensive to install in the first place. The first cost is higher in reference to the motors themselves and the dynamo, but in respect to maintenance they are cheaper. And there is another little thing that I would like to ask: In installing your power plant, which is the best kind of a dynamo to put in, slow speed with a large engine—which is not subject to deterioration—or a smaller dynamo with a high-speed engine? Of course with the slow-speed engine it will take up a good deal more floor space, but with a high-speed engine you can save that.

MR. POMEROY:—Answering the latter portion of the question first, I would say that, generally speaking, for direct driven generators the lower the speed the higher the cost of the generator. For example: from speeds of 90 revolutions per minute to 70 revolutions per minute the increased cost is very noticeable, but if you have in mind the use of shop engines now in place, or the purchase of slow or moderate speed engines, the generator could be belt driven, thereby enabling the purchase of the lowest priced generator and taking care of the speed requirements of the generator by the relation between the diameter of the pulley of the engine and that of the motor.

As to the question of comparative repairs of A. C. and D. C. motors, I do not happen to have any figures with me, but perhaps the case of a large agricultural machine plant in the West may apply. This concern has an aggregate of 4,000 H.P. in induction and 600 H.P. in direct current motors. The cost of repairs per month amounted to $1.50 more for the 600 D. C. than for the 4,000 A. C. This should be qualified by saying there were no repairs on

the A. C. type and the amounts charged against it were for inspection and should more properly come under maintenance. This report covers a period of over two years.

It has been stated that 90 per cent. of the cost of repairs to D. C. motors was chargeable to commutation, but, even so, it is surprising how little repairs the present type of standard apparatus really requires when the motors are handled intelligently.

In reference to the group *vs.* individual drives, the subject naturally divides into two parts or conditions, viz., new and old shops. In the former case, by cooperation with the tool builders, the machines, where individual drives are desired, can be made so that the application of the motor will cost very little, as most of the builders have modified their patterns with direct reference to motor application. But in an old shop cases can be met where the cost to apply the motor was nearly as much as the cost of the motor or machine. Consequently, the use of a little "engineering common sense" is necessary in all cases, and also as to where it is best to draw the line between group and individual driving. From the nature of the case, group driving fulfills the requirements in very many cases because certain tools are doing special work, and if variation of speed is occasionally desired it can be met by using the back gears. It is very seldom the speed requires changing after the work is once set in the lathe, and when starting the proper gear is very easily applied to produce the required speed. This is particularly so with brass and turret lathes. Recent developments in other machine tools have taken away from the lathe a large amount of work for which it was formerly thought this machine was indispensable. Except in special cases, the boring of holes is now largely relegated to the chucking department. The accurate finishing of plain parts, and in many cases, of parts of considerable complication, is done in the grinding department, where repetition, even of small quantities, is possible, parts up to 2 feet long and 2 inches in diameter are sent to the turret machine department. It is now recognized that it is poor economy to make a polishing bench of a fine screw cutting lathe. It seems pretty well assured that in the future the lathe will be largely used as a roughing out machine, so that the tendency under piece work methods is to specialize the machines more and more, and

in consequence reduce the necessity of wide ranges of speed obtained wholly electrically.

One great advantage with the individual drive is the fact that with tools used intermittently they consume energy only when actually doing work, and very many times this fact decides the use of individual drive, rather than the ability to use variable speed. The foregoing will, I think, demonstrate why it is so hard to answer such a question off-hand and personally. As things are only relatively true, I do not feel qualified to give an intelligent answer without an opportunity of making a study of the conditions applying in each case.

MR. WEST:—Would not the total number of horse-power motors required to drive each machine independently, more than if they were properly grouped, offset the saving that would be derived from certain tools being idle? In other words, would you not be obliged to have a larger motor for each individual machine, say 5 machines, than you would if the five were all connected to one motor? Would not the total number of horse-power required as a safe limit be much more in that case than if they were all driven from one motor?

MR. POMEROY:—Yes; suppose, for example, you have four lathes in a group; if driven individually they might each require a three horse-power motor, but if placed in a group a seven horse-power motor, or even less, would probably meet all requirements, for advantage can be taken of the average load, as it rarely happens that all the tools will require the maximum power simultaneously. Yet, if each lathe was individually driven, the aggregate horse-power would be 12, still the load on the generator would probably be about the same, with the possible difference that the seven horse-power motor driving the group would be working at a greater efficiency because loaded nearer the rated capacity.

MR. MURRAY:—The reason I asked the question was because I understand the Philadelphia & Reading are grouped, and I understood the Pittsburg & Lake Erie are using individual drives on their machines.

THE VICE-PRESIDENT:—Is there any further discussion of the subject?

MR MELLON:—I think Mr. Pomeroy's paper is an excellent one and I would not like to see the matter dropped without a thorough discussion by any members who may have had any experience with such equipment, and I would like to have any members who have had any experience to discuss the matter thoroughly before it is dropped. I would like to ask Mr. Pomeroy a question as to whether he can give us any statistics as to the cost of repairs on motors, say, of a 500 horse-power shop, in a year; and whether the operators on the various machines have to do any work on the motors?

MR. POMEROY:—I know of no cases where the tool operators do any work on the motors.

I do not have with me any specific data covering your question. Mr. Gibbs, in his paper before the M. M. Association, and Mr. Vauclain, before the Franklin Institute, cover these points quite comprehensively.

In the Baldwin Locomotive Works, with an aggregate of 450 horse-power in motors, the cost of maintenance per unit of output is so very small as to be negligible.

MR. WILLIAMS:—I would like to ask Mr. Pomeroy to explain the difference in cost of running a motor at a high voltage over a low voltage. You referred to one as costing more than the other.

MR. POMEROY:—It is the first cost that would be more. The cost of operation would not be relatively greater except perhaps where the per cent. of efficiency due to loading might apply. A motor at one-quarter load is not working at as good an efficiency as when working at full load capacity.

MR. WILLIAMS:—The point is, should we buy a motor the rated capacity of which is equal to the greatest load it would be required to carry, or should we buy a motor with a capacity equal to the average load and allow the motor to be overloaded for short intervals? Which would be the cheaper and most practicable in the long run?

MR. POMEROY:—This is illustrated very well in the case of a planer of a given capacity, driven, say, by a 15 horse-power motor. At the instant of reversal the power might run up to 20 or 25 horse-power. It would not be necessary on this account to apply a 20 or 25 horse-power motor, as this draught on the motor is just for an instant,

and all standard motors are so conservatively rated that it would be safe and proper to ignore this momentary overload. It might be of interest to know that if the planer were driven through a magnetic clutch, this overload, instead of being 80 to 100 per cent. would be about 5 to 15 per cent.

But one of the principal points I had in mind in presenting the paper was to try and demonstrate the desirability of a conservative range of variable speed, obtained wholly by electrical means.

Assuming that, so far as railroad shops are concerned, the several tools are selected with direct reference to the performance of a certain class of work and that the highest degree of efficiency is obtained where the tools are so operated. Calling this "zone" the "*normal*" and conditions of working other than the foregoing the "*abnormal*" zone; is it not true that when the tool is operating under normal conditions the necessity for variation in speed is quite limited? Is it not also true that the tools in a well organized shop are working well within the normal limits for, say, 80 per cent. of the time, so that the abnormal conditions are accidental and exceptional? Assuming this to be true, if, then, a simple and, for this reason, less costly, form of applying power could be provided to cover all the normal requirements, is this not all that is necessary? Could not the abnormal or exceptional conditions be handled by use of the back gears, or even by retaining the step cone pulley?

In a great many cases the normal conditions can be met by a 2 to 1 range of speed obtained electrically. This range would hold good with or be multiplied by every back gear combination. A 2 to 1 speed control can be met by the two wire system, combined with field control, as described.

Where a greater range is required, the use of a neutral wire, as mentioned, may be used, making a three wire system, giving a range of 4 to 1. To illustrate, assume the case of a 72 inch boring mill. The range of table speed multiplied by the maximum cutting speed in feet per minute, divided by minimum cutting speed in feet per minute, equals the number of speeds required. Calling the normal diameter of work 72 inches maximum to 36 inches minimum, maximum cutting speed 30 feet per minute, minimum 15 feet per minute, then the number of speeds would equal $\frac{72 \times 30}{36 \times 15} = 4$. That is to say, all changes from 72 inches to 36 inches in diameter,

and all speeds from 15 to 30 feet per minute could be electrically produced almost instantaneously by means of a suitable controller. Also, this range would apply for each speed combination possible, obtained by means of the back gears. Now, as to the abnormal range: Should it be necessary, on account of accident or exceptional conditions, to bore out a driving box or eccentric strap on this machine, the proper speed could be obtained by use of the back gears. Consequently, we are led to conclude that it would hardly be advisable from a commercial standpoint to provide, wholly electrically, for both the normal and the abnormal conditions. As the shop economies are to be effected by the facility of handling the normal scope or zone of the machine, in nearly all cases providing for a range of speed corresponding to the steps on the cone pulley, which can be used in conjunction with the back gears, covers, in the writer's judgment, all requirements of the railway shop tool. The maximum and minimum speeds are limited by the character of the work; the number of speeds is determined by the character of the metal and tool steel; the power by the severest conditions imposed.

MR. MURRAY:—There is one point that has not been touched on that I would like to mention. Motors; as far as my experience goes with them, are all run at a high speed. Of course, if you want a low-speed motor you have got to buy a very large motor and it depends on the winding, but for an ordinary motor, five or six horse-power, the speed of the pulley is up to 8, 10, 13 or 14 hundred revolutions per minute. We have only got a few motors down there, ten or twelve, but we have occasion to work at slow speed and they back-geared those motors; that is, they put a pinion on the armature shaft and a large cog-wheel on the other and pulley on opposite end. These motors, I find, the armature wears down, sparks more than on the others; I suppose it is on account of the back-gearing jarring. Would the jarring of the motor cause the brushes to spark and wear away the commutator faster than it would if we had belted to a countershaft direct and then reduced by belting and pulleys?

Mr. POMEROY:—I do not know, because there is no inherent reason why such results should be due to the combination you name, and I must, therefore, conclude the wear was due to other causes.

THE VICE-PRESIDENT:—Is there anything further under this head? If not we will close the discussion.

I would like a motion made to receive the report of the auditing committee as to the Treasurer's books; that was not embodied under the subject of the auditing committee's report.

MR. MOONEY:—I move the auditing committee's report be received and accepted. Carried.

MR. MOONEY:—Mr. Chairman, I move a vote of thanks be tendered to Mr. Pomeroy for his excellent paper.

Seconded and carried.

THE VICE-PRESIDENT:—Is there anything to bring before the Club under the head of new business?

THE SECRETARY:—Nothing, Mr. President.

THE VICE-PRESIDENT:—Reports of special committees and reading of papers. We have the pleasure to-day of introducing to the Club Dr. Charles E. Lucke, of Columbia University, who will entertain the Club with a discussion on "The Indicator as an Engineer's Instrument."

Dr. Lucke then presented his paper.

"THE INDICATOR AS AN ENGINEER'S INSTRUMENT."

The number and variety of the problems that can be solved by the indicator has increased enormously since that instrument was first designed and used by Watt, but the principles underlying the solution, whether applying to steam, gas engine, air compressor or pump work, are simple, easily understood and invariable. It is the object of this paper to present a few collected problems for solution to illustrate the principles and to bring together the work in the different fields rather with the intention of showing the relations between them and the interdependence of one with the other than to attempt to solve all the problems of any one field, this will result in a short treatment of the utility of the indicator as an engineer's instrument.

The indicator is an instrument constructed primarily to record on a piece of paper the pressure existing in a closed chamber at any period of time and to record also the changes in pressure in that chamber as time advances or at each instant of any lengthened period. With few exceptions the period during which a record is desired is that of one stroke of a piston within a cylinder and the pressure chamber may be the cylinder itself, the pipe leading to, or the pipe leading from the cylinder. From these recorded pressures for

each point of the stroke it is possible to compute the other results, and these computed quantities might be called the secondary results of the use of the instrument.

To record the pressure, a small piston, working freely in a cylinder, is acted upon on one side by the pressure in question and on the other side by a spring whose deflection in inches is known to represent so many pounds, the piston rod actuates a pencil vertically, and the distance the pencil moves represents so many pounds acting on the piston. In practice the pistons are constructed with an area of one-half square inch for general use and with one-quarter square inch area for gas engine use. The pencil is not carried directly on the piston rod but on a long arm with various link connections to exaggerate the motion of the piston rod at the pencil point while still causing the pencil to move in a straight line parallel to the piston rod. The pencil moves along a drum which may be moved in unison with the engine piston but always turning about the same amount no matter what the distance moved by the engine piston.

It will be assumed that the connecting up of an indicator and the manipulation of the instrument itself is familiar to engineers, for much information on the subject may be found in catologs, works on the steam engine and in the technical journals. For the purposes of discussion and reference several indicators of different makes are shown and a motor-driven model will serve to illustrate the operation of taking the card.

It is rather in interpreting the card, *i.e.*, in being able to understand what the various lines thereon mean that it presents the greatest difficulty to men about to use the instrument, and it is to this side of the question that we will give most attention. The indicator will record truly the interior pressure and if it be always borne in mind just why at times the pressure might be constant rising or falling and what influences are present that might bring about the changes of pressure observed there will be little trouble in reading correctly the diagram. It might be mentioned here, however, that without knowing all the circumstances surrounding the taking of a diagram it is impossible to correctly interpret it and what should be a clear, positive judgment will degenerate into a mere guess.

Character of the Expansion Line.

Suppose a mass of steam, air or other gases confined in a cylinder and the piston moving out increasing the volume of the chamber in which the gases are confined, the curve that will be drawn by the indicator is called the expansion line and is such that there will always be a certain relation between the pressure existing at any time and the volume of gases confined. For the general run of steam engines it has been found that $PV.=C$, *i.e.*, the product of the pressure and volume is the same everywhere on the curve. If now the piston be forcibly returned and the gas still confined the resulting curve is the compression line and will be exactly the same as the expansion line. If on the contrary

some of the gases escaped before compression the compression line would not return on the expansion line but would still have the same relation between pressure and volume thus Fig. 1 $P_aV_a=P_bV_b$ and $P_cV_c=P_dV_d$ but these con-

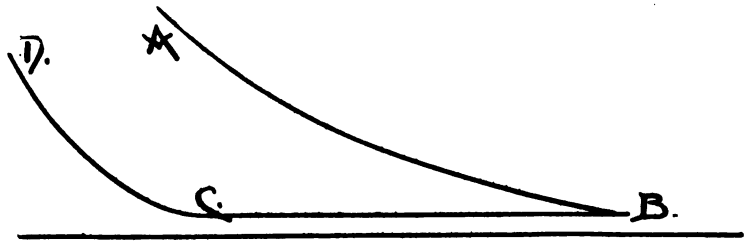

Fig. I.

stants are not the same. Expansions and compressions having this equation are called logarithmic or hyperbolic for saturated steam and isothermal or constant temperature for air and other gases. If air or other gases expand or compress without losing any heat the resulting curve is called adiabatic and has the equation P. V. 1.406-C it will be noted that the exponent 1.406 of the volume for adiabatic curves becomes 1,000 for isothermal curves. If steam expand or compress without losing any heat the adiabatic curve for steam resulting has the equation $PV^{\frac{17}{16}}=C$. If the steam expand or contract in a non conducting cylinder it will be found that the work done is greater than the difference between the total heats for the two pressures found in the table, hence some heat must have been set free by a little condensation the equation of the curve will be $PV^{\frac{19}{19}}=C$ this condensation is entirely apart from what results initially on admission of HP steam to a cooler cylinder. In practice great complication results from wall action but most computations are made on the assumption of hyperbolic expansion. If saturated steam be heated it becomes superheated and acts like a perfect gas, the equation of the expansion curve for saturated steam would be $PV^{1.3}C$ the exponent here is 1.3 very nearly what we find for air compressed in water jacketed cylinders.

In air compressors it is necessary that as much heat as possible be abstracted during the compression to prevent contraction and pressure drop from cooling in the discharge line, so water jackets are provided and often water injetecd into the mass. If enough heat could be abstracted to keep the temperature always equal to the original we would get a curve PV=C. If no heat were abstracted we would have a curve $PV^{1.4}C$. In practice the exponent varies, the lowest ever attained being about 1.2 and from this up to 1.38, so an air

compression curve might lie between $PV^{1.3}C$ and $PV^{1.38}C$. The impossibility of keeping this exponent down leads to multiple stage compression with coolers between cylinders.

In gas and oil engines where an explosive mixture of air and gas or vapor is drawn in, compressed, exploded and expanded it is found that the mean value for the compression curve is 1.35, so that $PV^{1.35}C$ but this varies with a great many conditions and any one curve may have a different exponent for different parts, for example, near the beginning the exponent might be 1.4 and near the end as low as 1.00.

The expansion line in the gas engine is also of a variable nature; at the beginning the hot gas loses heat fast to the walls, making the curve very steep; combustion may not be complete and the curve may be flatter, while toward the end the curve becomes quite flat. The two ends of the curve will in general lie on a curve with the equation $PV^{1.41}C$ though the actual curve may cross this by lying partly above and partly below.

No Expansion Line.

If the cylinder be in communication with a supply at constant pressure, such as a large steam pipe during the motion of the piston, there will be no

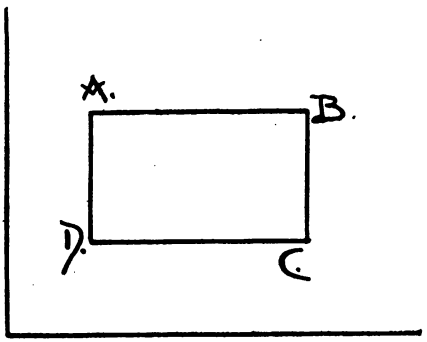

Fig. II.

expansion and the line horizontal or constant pressure A B Fig. II. The same would result if the cylinder were open to the atmosphere, a line thus drawn is the atmospheric line, C D Fig. II. This is similarly the result when a pump sucks water or discharges it slowly.

No Motion Line.

When the piston is stationary any changes of pressure will appear as vertical lines only A D and C B Fig. II. This is what would result when a pump suddenly stopped discharging and began to suck, or when steam were suddenly admitted to a cylinder while the piston moved slowly or not at all, or when a charge explodes in a gas engine cylinder if the piston be still or moving slowly.

Complex Lines, Throttling and Wiredrawing.

The constant pressure lines of Fig. II., AB and CD result only when the openings are large and the piston moves slowly, or when the velocity of the entering or leaving gases is below a certain figure. If on the admission A B the piston moved very fast or the opening was so small as to give the entering gases too high a velocity, the pressure would fall, the gases never quite catching

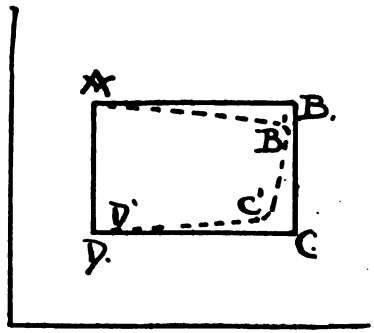

Fig. III.

the piston, as it were, giving a line AB Fig. III. This effect is called "wire-drawing" and is the drop in pressure due to too fast a piston or too small an opening. In a similar way, if along the line BC Fig. II., where the pressure were to drop suddenly if the piston speed were too high or opening too small, there would be a bend to the left B'C'. There might also result a round corner at B and C from the same cause. These effects, like C'D' or AB' are often known as throttling effects and result in changes of pressure due to attempts of the gases entering or leaving to pass obstructions compared to what would result were the obstructions removed.

Area of Card Represents Work.

As verticals represent pressures and horizontal distances on the card, the area of the card represents work to some scale. Just what scale is easily determined. If the stroke be 24 inches and the card 3 inches long, then horizontals on card represent two feet to three inches, or one inch stands for 2-3 foot. If the scale of the spring be 80 and the piston area 50 square inches, then each vertical inch represents 50x80—400 lbs. pressure on the piston, and to these scales the area shows the number of foot pounds of work per stroke.

In practice it is not usual to proceed this way. The mean pressure of one forward and one return stroke is found and this is assumed to have acted through a number of feet equal to the stroke. The mean pressure of one forward and one return stroke on one side of a piston is the mean effective pressure and is found as follows :

To Find Mean Effective Pressure.

First, find the mean height of the card in inches. This mean height or mean ordinate may be found in several ways, two being in common use.

1. Draw two vertical lines (Fig. IV.) tangent to the curve and divide the

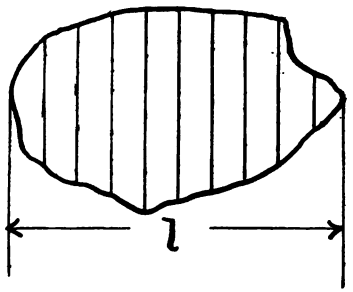

Fig IV

distance between them (l) into a large number of equal parts not less than 10.

Measure the length of each line included within the curve, relay off with dividers a length equal to the sum of all. Divide this long line into as many parts as there were lines; this will give the mean ordinate in inches. If this mean ordinate be multiplied by the scale of the spring used, the result will be the mean effective pressure in pounds per square inch, and this in turn multiplied by the area of the piston is the mean force acting on the piston in pounds.

2. By the planimeter. Some instruments are arranged to give the results at once, but the ordinary Amsler or the simplified Amsler instrument will read areas only. The area of the card in square inches divided by the length in inches, gives the mean ordinate in inches, from which MEP is

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the tracing point carried around a circle whose radius is R, there will be no record. All areas A within this circle will be recorded positive and all outside B negatively, and any area lying on the circle C will have the part outside subtracted from the part inside, and one has no way of knowing when this has happened unless he is careful to observe the following: It is not practicable to always draw the zero circle, but all that is necessary is to prevent the tracing point from crossing the unknown circle at any time, and this is easily prevented by so placing the card that the plane of the wheel shall never cross the fixed point when the tracing point is run over the diagram.

Steam Problems.

To move a piston against resistance with steam requires

1. That during a period steam be admitted.
2. That during a period steam be exhausted.

This is quite sufficient and is what occurs in many small pumps and a few large ones. Fig. II shows a diagram such as should result; O'T is the atmospheric and OV the perfect vacuum line; if a condenser were receiving the exhaust along vacuum line T representing the lowest pressure, some additional work may be secured.

It was stated above that the two operations of steam admission and discharge are sufficient to cause the desired motion and do work, but this method is not economical because a volume of steam at boiler pressure is thrown away each stroke. If this were confined behind a piston it would expand and do more work, if expanded to the lowest pressure all the work that could possibly be obtained from the steam would be secured, so that it is desirable for economy to cut off the supply at some point and allow the steam to expand, getting more work from the same quantity. In actual steam engine practice it is impossible not to leave some space between the piston at end of stroke and the valve face. Such space is called "clearance."

It is found desirable to close the exhaust before the end of the stroke and so to compress the trapped steam into the clearance space which would otherwise have to be filled with live steam before the piston began to move. This not only decreases waste but acts as a cushion for the piston and moving points, helping to change the direction of their motion without shock.

In economical steam use, then, there is found four periods:

		Steam Valve.	*Exhaust Valve.*
1.	Admission (FAB).....	Open	Shut
2.	Expansion (BC).....	Shut	Shut
3.	Exhaust (CDE).....	Shut	Open
4.	Compression (ET).....	Shut	Shut

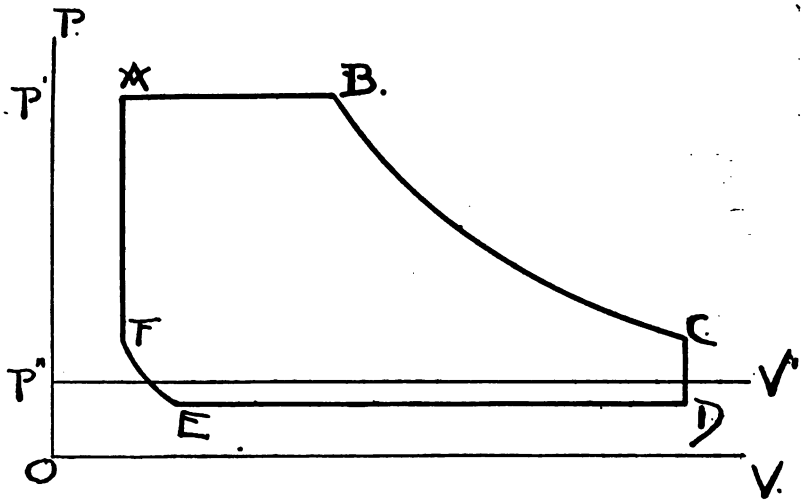


Fig VI.

The points of division between these periods are called:

1. Cutoff (B).
2. Release (C).
3. Compression (E).
4. Admission (F)

The distance P'A is the clearance, and line OV perfect vacuum; P''V' the atmospheric line. The only lines drawn by the indicator are the complete card and the atmospheric line. The perfect vacuum is laid off below the atmospheric line, a distance corresponding to barometic reading, which in most cases may be taken 14.7 or 15 pounds per square inch to the proper scale. The line of zero volume (OP) is laid off to the left of the card a distance representing the clearance to the proper scale, and the clearance is found as follows:

To Find Clearance.

(*a*) *By actual measure.*—Put the engine on center and fill space between valve seat and piston with water, and measure the amount. Great care must be exercised in getting out air which prevents water entering and in preventing water from leaking past the valves or piston; one makes clearance too small and the other too big. The details for each case must be left to each man's own ingenuity.

(*b*) *From the cards.*—If a good clear compression curve can be had and it is certain there are no leaks, the clearance can be found from a property of the hyperbola. A rectangle constructed on two points of the curve as corners will always be such that a diagonal through the other two corners will intersect the perfect vacuum line on the line of the volumes.

Take any two points (AB) on the compression curve (Fig. VII.), and

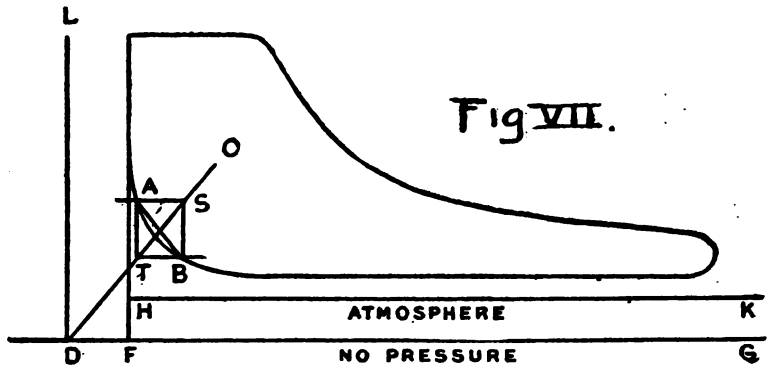


Fig VII.

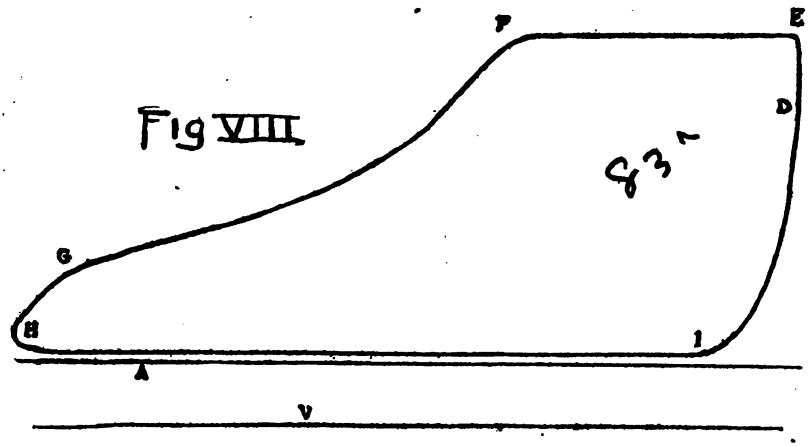
through these points draw horizontal and vertical lines ASTB and TABS, forming the rectangle ASBT. Now through S and T draw CD; where this line intersects the line of no pressure, as at D, erect the perpendicular DL. This will be the clearance line, and DF, expressed in per cent. of stroke, will be the clearance.

Names of the Lines Making Up the Four Periods.

The different lines on the diagram are given names which are in quite general use, though in various sections of the country, practice varies somewhat in these names; as we will need to use some names later in analyzing cards it will be well to adopt the following:

Let Fig. VIII represent a diagram from a non-condensing automatic cut off engine. A is the atmospheric line. This line, though traced by the pencil of the indicator, has no connection with the conditions existing in the cylinder of

the engine. It is drawn, when the indicator-cock is turned so as to close the communication between the indicator and engine cylinders, and with atmos-



pheric pressure on both sides of the indicator-piston. It is of the first importance to establish this line correctly; it is the neutral line of the diagram, and from it all pressures above and below it must be determined.

V is the line of perfect vacuum, or no pressure: this line is drawn by hand at a distance below A equal, by the scale of the spring, to the pressure of the atmosphere. When this pressure is not known, it is at ordinary altitudes assumed to be 14.7 pounds per square inch. This is about the average pressure at the sea level; at high altitudes it is less.

DE is the admission-line, so-called because its beginning, D, represents the point in the stroke of the engine at which the steam-valve begins to admit steam to the cylinder.

EF is the steam-line, considered as beginning at the point of positive change in direction of the admission-line, as at E, and terminating at the point of cut-off, F.

The expansion-line, FG, is traced after admission of steam to the cylinder has ceased, the pressure falling by expansion while the piston is travelling a distance represented on the diagram by the distance horizontally from F G.

The exhaust line begins with the opening of the exhaust-valve at G, and continues to the end of the forward and beginning of the return stroke.

HI is the line of counter-pressure, beginning with the return stroke and continuing to I, at which point the exhaust-valve is closed.

The compression-line begins at I and continues to D, the pressure rising as the steam remaining in the cylinder is compressed into less volume.

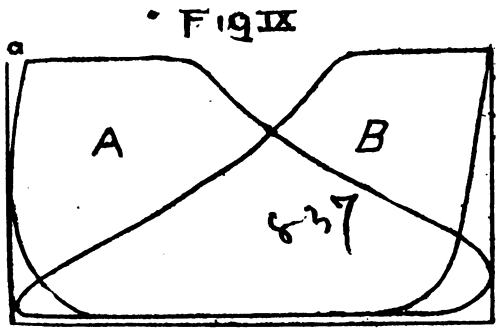
Valve Action.

Just what will be the extent of the periods and just when each of the points will occur is determined by the valves. Different types of valves will involve different relations between these periods. For example, a plain D slide valve admits and cuts off steam by the same edge, another edge controls release and compression. One type of gridiron valve has admission and cut off controlled by different edges while another edge controlls release and compression, other types may control the periods otherwise. With Corliss gear one valve looks after admission and cut off while another controls release and compression.

On any one type of valves these periods may have a certain dependence one on the other, with a plain slide valve moving to the left, steam is cut off from the left end of the cylinder and released on the right, an earlier left movement makes both the left hand cut off and right hand release earlier. With two eccentric Corliss gear everything may be made independent of everything else. Steam is admitted by lifting the hook, and this is done by a rigid though adjustable connection of eccentric and rods. Release is controlled similarly but by separate eccentric and rods. Cut-off is affected by the hook trip position of which is controlled by the governor and is further adjustable by rod lengths. Compression results from the exhaust valve trip which may be adjusted independent of everything else.

Lead.

Suppose the indicator is applied to an engine, the result being a pair of diagrams similiar to those represented in Fig. IX.



In Fig. VIII. the admission-line is vertical, showing that the steam-valve opened sufficiently to admit steam to fill the clearance-space at about boiler-pressure before the piston began its stroke. In A, Fig. IX., the admission line is inclined in the direction of the stroke of the piston. We should infer that the

valve began to admit steam just as the piston began its forward stroke, instead of, as in the more common practice, just before the termination of the return stroke.

Generally prompt admission is favored by engineers, the argument being that the cylinder and piston having been cooled during exhaust, the exposed surfaces should be heated as early in the stroke as practicable. On the other hand, it is reasoned by those who favor late admission, that while the crank is at and near the dead-center, pressure against the piston will have no effect to turn the shaft, but on the contrary will create friction on the pins and main journals, which tend toward preventing its turning; for this reason they advise that the pressure in the cylinder be kept low at this time.

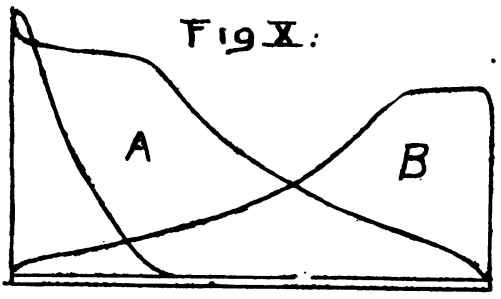
When the ports are small or when the clearance is large, late admission may result in a low steam-line (low compared with boiler pressure), which is a condition unfavorable to ecomony; in such cases the valve should have lead. In other cases it may or may not have lead, according as the engine runs smoother with or without it.

Referring to B, Fig. IX from the other end of the cylinder, it will be seen that conditions contrary to those in A exist; that the steam-valve on this end opens considerably before the end of the return stroke. (By forward stroke, that stroke of the piston in which steam is admitted to the end of the cylinder under consideration is understood; by return stroke, its stroke in the opposite direction). The lead is excessive on this end. Equalizing the lead will make it about like that in Fig. VIII on both ends.

With some valve gears a single adjustment will correct both; with others, two or more adjustments may be necessary.

Early and Late Exhaust-Closure.

Card A, Fig. X shows too much compression. By early exhaust-closure the pressure behind the piston is increased, until before the completion of the return



stroke it is higher than that in the steam-chest; then when the steam-valve opens the presssure falls, making a loop in the diagram. The remedy for this

is to bring about later closure of the exhaust-valve. Modern practice largely favors, when practicable, an exhaust-closure that will compress the imprisoned steam to about two-thirds as high as initial pressure. Fig. VIII. shows compression to that extent, and is about right.

The argument in favor of compression is that it fills the clearance-space with steam that would otherwise be wasted, and thus effects a direct saving of steam, which is true to a certain extent; also, that it tends to smooth running, which is equally true. There is always some looseness in the main journals and connecting-rod boxes, and this, if taken up suddenly, as it is when steam of high pressure is instantly brought to act on the piston, produces a jar or pound. If the exhaust-valve is closed at the proper time in the stroke, the pressure on the exhaust side of the piston increases until it equals and then becomes greater than the pressure urging the piston along; this comes about so gradually that the tendency is to take up what lost motion there may be in the same gradual manner.

Increasing compression will not always stop pounding in an engine; but when it is quite low, increasing it will generally have an effect that way. Some engines run satisfactorily, so far as the jar is concerned, with little or no compression. To be much service in bringing about smooth running, compression should be carried to a higher point than the pressure in the other end of the cylinder at the termination of the stroke. If we suppose the diagram from the other end of the cylinder to be a duplicate of that shown in Fig. VIII. then the pressure at the end of the compression-line, as at D, should be higher than at G. If the pressure is enough higher at D than at the end of expansion to have gradually overcome the forward pressure, and the momentum of the reciprocating parts, all will have been done that can be by compression to insure still running. To insure an arresting of tendency to motion in one direction and a tendency to motion in the opposite direction of the reciprocating parts, the pressure, except in case of low speed, must be materially higher at D than at C.

In B, Fig. X. the exhaust-valve closes too late. There is no compression, showing that the exhaust is open until the end of the stroke. The exhaust-valve should be made to close earlier in B and later in A.

Early and Late Exhaust-Opening—Back-Pressure.

Moderately early exhaust-opening, as represented at G, Fig. VIII., gives time for the escape of steam before the piston begins its return stroke, and assists in keeping the back-pressure low. As the piston gets near the end of its stroke, pressure on it is nearly all, then entirely, spent in creating friction; so it is always advantageous in this respect to open the exhaust before the end of the stroke. It is very seldom that diagrams from stationary engines are seen which represent actual loss from too early exhaust-opening; very frequently diagrams that represent a loss of from 1 to 5 pounds in back-pressure from late

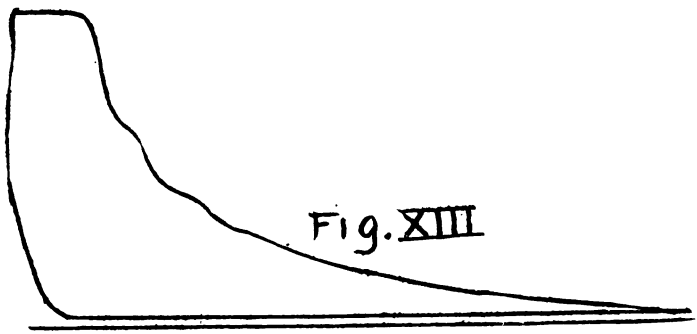
exhaust are met with. The matter of exhaust opening and closure is only to a limited extent in the hands of the engineer, as it is largely controlled by the designs of the builders. The engineer frequently finds himself obliged to compromise as between too much tendency to pound and a loss from back-pressure.

The back-pressure in a non-condensing engine, represented by the distance apart of the atmospheric line and the line of counter pressure, varies with the construction of the engine, the speed at which it runs, and the adjustment of the valves, and to a considerable extent with the pressure in the cylinder and exhaust-opening. Sometimes it is as little as one-half pound—even less; but two pounds is nearer an average. Excessive back-pressure may be caused by small ports, small exhaust-pipe, or tortuous passages. Late exhaust-opening, as previously referred to, tends to increase back-pressure; the presence of water in the cylinder has the same tendency.

Fig. XI. shows a card from an engine with a late opening of exhaust and considerable back-pressure.

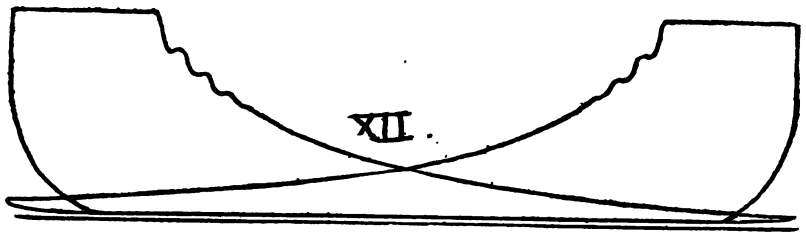
The Expansion Lines.

Expansion lines suffer from two causes of derangement: one due to improper recording of the indicator; the other due to real engine troubles. The indicator faults result in wavy and step-like lines or serrated lines. The wavy lines of Fig. XIII result from natural causes, from high piston-speed,



reaction of the spring, and momentum of the reciprocating parts of the indicator. When the waves are symmetrically rounded and not too intense—not much more so than in Fig. XIII they do not materially affect the truth of the diagram. When the undulations are considerably more intense than in this figure, the remedy is to use a stronger spring, and sometimes to shorten the motion of the paper-drum.

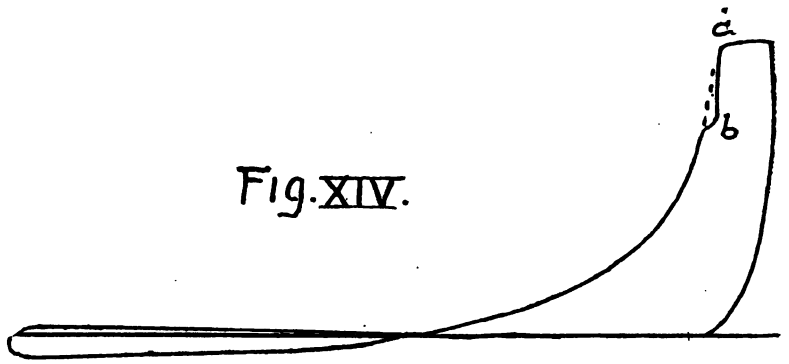
Serrated lines, as in Fig. XII are evidence of undue friction in some of the



parts of the indicator, and make the diagram worthless. Sometimes when the instrument is new the piston may be a trifle tight—so much so as to stick to the cylinder. The remedy is to attach the indicator to an engine (not connecting the drum-motion), and, keeping all parts well oiled, let it work for an hour or two.

Reopening of the Steam-Valve.

Diagram XIV shows peculiarities in the expansion-line which are sometimes



taken as representing improper action of the indicator. The real cause is worth investigation. It will be noticed that the expansion-line from A to B is substantially vertical in direction. This is only observed where the clearance is small. In such instances the pressure in the cylinder falls very rapidly directly after cut-off, because a small movement of the piston will serve to increase largely the volume of steam in the cylinder as compared with the volume at cut-off, and correspondingly decrease the pressure. In the cylinder from which this diagram was taken the clearance marked on the diagram is .0253 of the displacement of the piston, and the cut-off is about 1-15 of the

stroke. The steam being cut off with the suddenness of a blow at A, the piston travelling at a mean speed of between 500 and 600 feet per minute, and the distance horizontally from A to B representing less than one-inch motion of the piston, it will be seen that the pressure under the indicator-piston is almost instantly reduced. The spring being under considerable tension starts the indicator piston down, and the mometum which it soon acquires carries the pencil ahead of the position due to the steam-pressure, precisely as in diagrams from high-speed engines, or in those taken with a light spring, the pencil is found alternately too low and too high, the result being, a little later in the stroke, a regularly undulating line that is correctly taken as evidence of correct action of the indicator. In these instances the pencil will fall below its correct position, then the reaction will carry it above, and so on. In this instance the first evidence of reaction is at B, which is where the reciprocating parts of the indicator recover from the effects of their downward impetus. Had this occurred later the pencil would have been carried up considerably out of its true course, but at this early point in the stroke the pressure is falling too rapidly for this to occur, so that the reaction amounts to scarcely more than a pause in the downward motion. Below B a short distance there is another pause, after which the expansion-line gets into proper shape, being assisted by the more gradual fall in pressure as the volume of steam is increased. As previously noted, had precisely the same thing occurred later in the stroke, as from a cut-off when the volume of steam in the cylinder was twice or three times as great, the result would have been the wavy expansion-line frequently seen.

But there is still another cause that tends to produce a straight line from A to B. The actual curve of the diagram is usually found below the theoretical curve directly after cut-off, especially where full steam is worked for a small fraction of the stroke only, from the fact that condensation is taking place with great rapidity to supply the heat lost by the exposed surfaces during expansion and exhaust; so that taking into consideration both these causes, each operating in the same direction, the position of the line from A to B is logically accounted for without attributing any fault to the indicator, which, so far as can be seen from the diagram, was in good working condition. Finally, drawing the theoretical curve from the point of cut-off, the variation is not nearly so great as a glance at the diagram would seem to indicate. A part of this curve is drawn in dotted lines, and shows the variation a little greater than it actually is.

Fig. XV. shows peculiarities that cannot be explained in this way. The initial pressure was 60 pounds—one pound less than boiler-pressure—and the valve closed very sharply at C, after the piston had made a small fraction—about five per cent.—of its stroke. The effort to recover after the usual somewhat too rapid fall of the pencil is seen at D, and from some cause the pressure rises again to nearly 60 pounds, making, apparently, two points, C, C, of cut-off. The cause of this was that the cut-off valve, which dropped in closing, afterward left its seat, and from the amplitude of the steam-ports actually

admitted steam of nearly boiler pressure the second time. From a short distance below C the line falls too slowly for some distance, showing that the

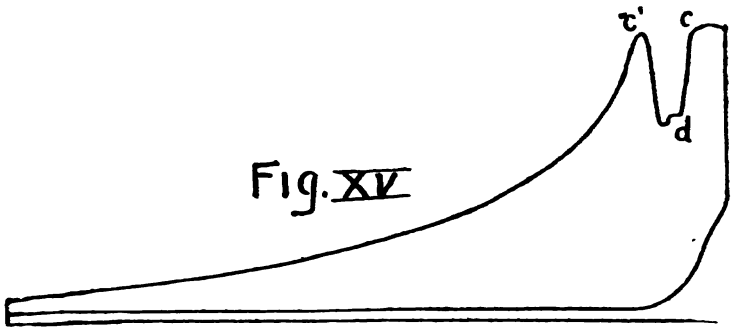


Fig. XV

valve leaked while settling back against its seat. The engine from which this diagram was taken was a small one, and the aggregate length of the ports controlled by the cut-off valve was equal to about twice the diameter of the cylinder. With this length of port the cut-off proper occurred while the valve was dropping at its highest velocity, and through only a very short distance. The effect of this was that the pressure in the cylinder was not reduced enough while the valve was closing so that the unbalanced pressure in the steam-chest would hold the valve to its seats against the jar of the air-cushion which stopped it.

There were two remedies that suggested themselves, one of which was to provide for closing the valve slower, and the other to arrange a guard to prevent the valve leaving the seat, horizontally. The last remedy was the one tried, with success.

Trouble similar to this, though not so marked in extent, often occurs in four-valve engines. The result generally appears somewhat later in the stroke in the form of an irregularity in the expansion line, as at Fig. XVI., followed

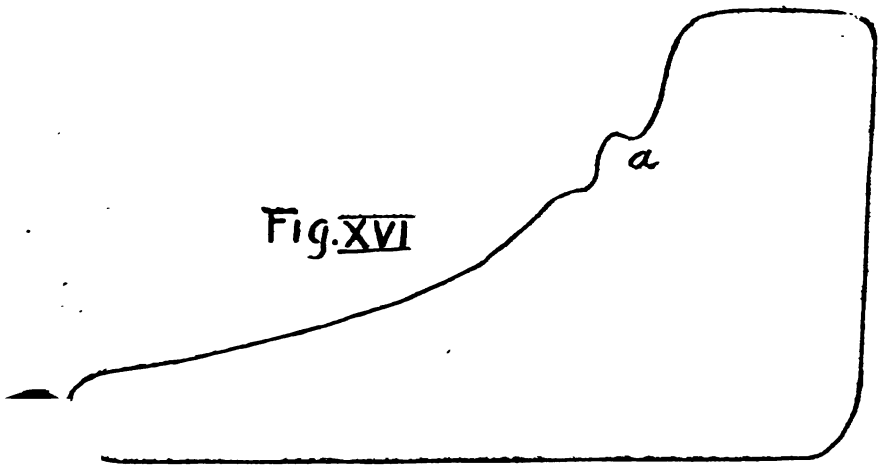


Fig. XVI

by an expansion-line and much too high terminal pressure. This is usually explained as being the result of wet steam, a small cylinder, or in any but the correct way. The true explanation is that the valve does not close properly, or reopens a little, and does not get properly seated until some distance beyond where cut-off *apparently* takes place. It is needless saying that this diagram represents an important waste of steam.

Fig. XVII. shows an old card from U. S. S. Magra, when lacking. Cut-off at C, reopen at A, release at B.

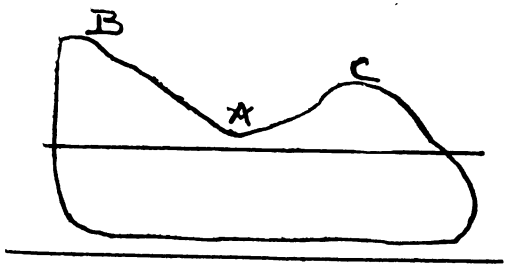


Fig XVII

Humps on Expansion Lines.

Fig. XVIII. shows a card from a vertical compound engine L. P. cylinder

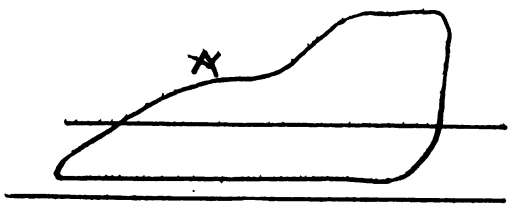
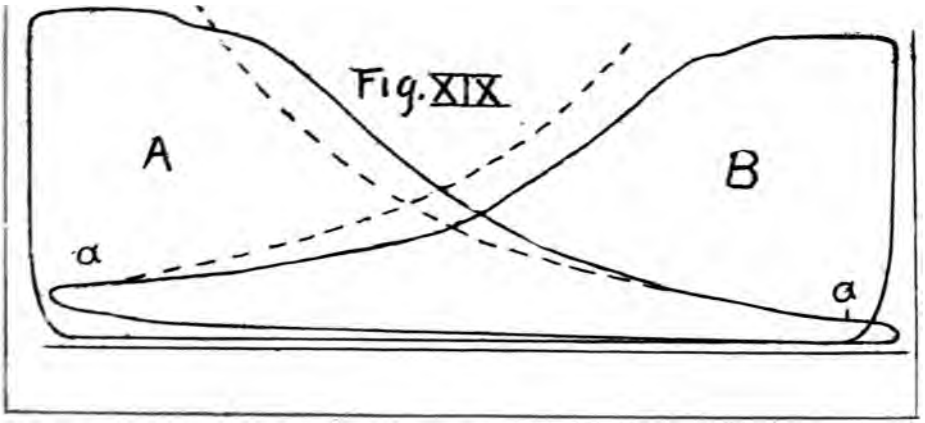


Fig XVIII

on which the lump A led to a hunt for steam leaks. A bye-pass valve used in starting was found partly open, so that live steam made its presence felt when the pressure fell low enough to permit the steam to flow fast enough through the partly open valve.

Leaky Steam and Exhaust Valves.

Cards Fig. XIX. are from a four-valve engine 20x60 inches, running at 57 revolutions; boiler-pressure about 70 pounds. They are not good ones The cut-off



is not as prompt as it usually is in this class of engines, and the exhaust opens too late. This late exhaust-opening results in a material loss from back-pressure at and near the beginning of the return stroke in B, and substantially the same loss would undoubtedly be shown in A if the terminal pressure were not so much lower.

Another fault is that the work done is not equalized between the two ends. This equalization should be brought about, and the exhaust-valves opened earlier in the stroke.

But the diagram shows evidence of a greater fault than either of these, viz., leaky valves. While the indicator cannot always be relied upon to detect leaky valves and piston if the leak is small, when it is large it will do so in almost every instance if the diagrams are taken from both ends of the cylinder. Leakage of steam into or out of the cylinder will influence the character of the expansion-curve. If steam leaks out of the cylinder, the terminal pressure will be lower than it otherwise would be; if it leaks into the cylinder it will be higher. If both steam and exhaust valves leak, the leaks might possibly balance each other, but there is no probability that this would be the case in each end of the cylinder.

At a piston speed of 400 to 600 feet per minnte, the terminal pressure should not, in cylinders of 12 inches and upward in diameter, be more than two pounds above the determination of the theoretical curve. If found higher than this, there is a probability of leaky steam-valves. If the theoretical curve ends lower than the actual curve, the presumption is that the exhaust-valves or the piston leaks.

In Fig. XIX. it is difficult to tell, even approximately where cut-off occurs, so expansion curves are drawn from a point just before exhaust opening. They show just as clearly that in B there is a good deal more steam present at the termination of the stroke than at cut-off, wherever it may have been, and that in A there was about as much less. There is every reason to conclude that in one instance steam leaks freely into the cylinder, and that in the other it leaks out about as freely. All the valves, steam and exhaust, probably leak, but on one end the steam-valve leaks most, while the same is true of the exhaust-valve on the other end. If both diagrams are like A, the leak *might* all be by the piston. If both were like B, it would be possible, but highly improbable, at this piston-speed that re-evaporation in the cylinder was the cause of the increased quantity of steam present. There would not be time at a piston-speed of nearly 600 feet to condense sufficient water to increase the quantity of steam to such an extent, or time to re-evaporate it if it entered the cylinder as water.

It may be remarked, that when a little too much steam is found in the cylinder at the end of the stroke, as indicated by the expansion curve drawn from near exhaust opening keeping just sensibly above the real curve, or the curve drawn from near cut-off falling a pound or two below it near the end of the stroke, it is accounted for, usually, by re-evaporation in the cylinder. But when too small an amount of steam is found it is evidence of leak; this refers to the use of ordinary steam, that is, steam that is not superheated.

There is evidence enough in either of these diagrams, considered singly, of leaky valves, but taken together the evidence is conclusive.

Card Fig. XX. shows another case of leak; the upper portion of the com-

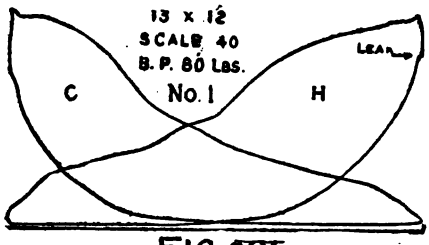


Fig. XX

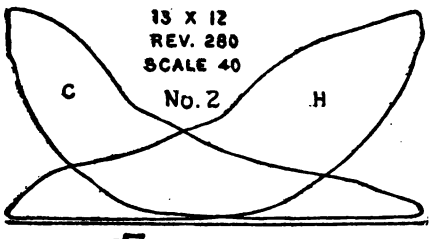
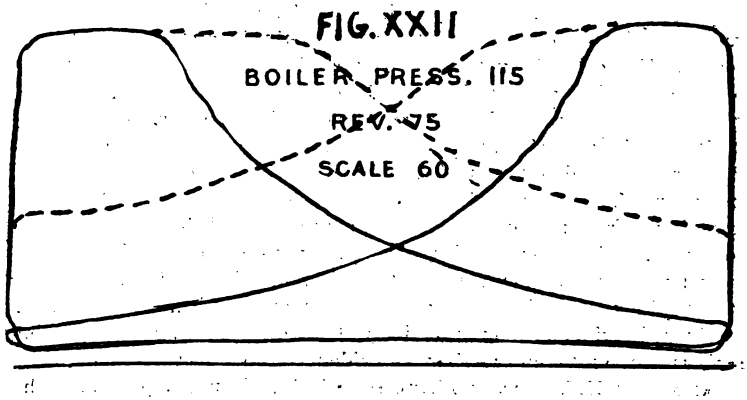


Fig. XXI.

pression curve leans out. This may be due to a leaky valve or piston. Fig. XXI. shows card from same engine after an attempt at repairs.

Economy of Working.

While, of course, the only true test of the economy of the working of an engine must be made by weighing the condensed steam, still something can be told at a glance from the card. Fig. XXII. shows two sets of cards, and it is



evident by the high exhaust pressure of the dotted cards that they show much less economy than the full line cards.

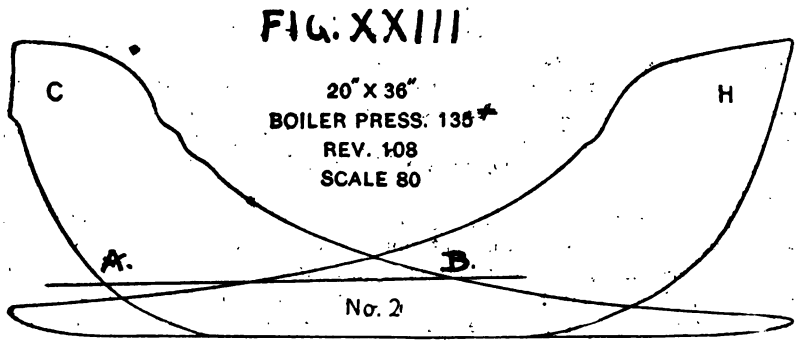
This, of course, may be necessary for a temporary overload; but if the usual thing, a larger engine would be better

Steam Consumption from Cards.

At any time of the stroke, when both inlet and exhaust valves are closed *i. e.*, during the expansion or compression periods, we can measure the volume and pressure of the steam confined; and looking up in the steam tables, can find the weight of such steam.

The amount supplied to the engine is the difference between what appears from the expansion line and that from the compression line. A rule for computing the amount of steam on this basis works out to the following form:

Draw a line (AB) intersecting compression and expansion lines (Fig. XXIII.); call its length *l*. Find the total length of card then will



$$Q = \frac{13{,}750\ l\ w}{P\ L}$$

where Q—pound steam per 1 h.p. per br.

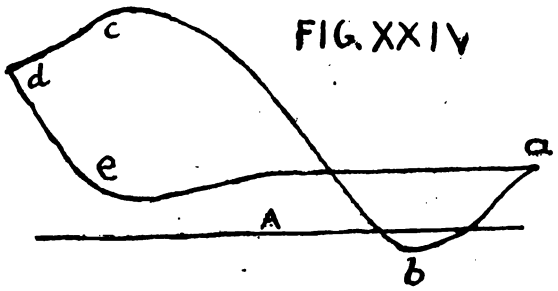
" W—weight 1 cubic foot steam at pressure m.

" P—MEP of card.

It is found that the amount of steam accounted for by the card thus is on an average 75 per cent. that shown by condensation and weighing. This does not affect seriously the use of the indicator as a means of comparison between the two cases, for invariably that card that shows by computation the least steam will be found by actual condensation and weighing to represent the best case.

Faults and Corrections.

Card Fig. XXIV. is one that at first is difficult to explain, but analysis soon



reveals the faults. At A piston advances, but as pressure drops the inlet port must be covered at B about one-quarter stroke, the valve begins to open the

port, but the motion of the piston is so rapid and the space to be filled with steam so large that the pressure increases slowly, as represented by the line BC; an aggravated case of late admission without assistance from compression. Under these conditions the upward bend of the line BC is accounted for, it is exactly what would be expected.

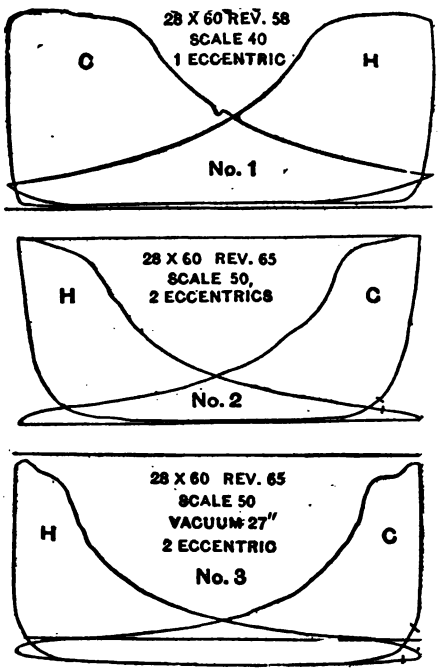
At C steam is cut off; CD is the expansion-line, concave downward and inward as it should be. The exhaust opens late at D, for which reason the pressure falls slowly, till beyond E it is equal to that against which the piston is working. The line from D, by E, to A is the line of counter-pressure, there being no compression.

The engine from which this diagram was taken is 22 by 30 inches, running at 75 revolutions. The engine kept running, doing its regular work with the misplaced eccentric, but pounded so badly the indicator was applied to ascertain the cause. The exhaust was against the high pressure shown, because the exhaust-steam at that pressure was used for other purposes requiring that pressure.

Sizes of Ports.

Fig. XXV shows a set of cards at different speeds, the steam line falling on

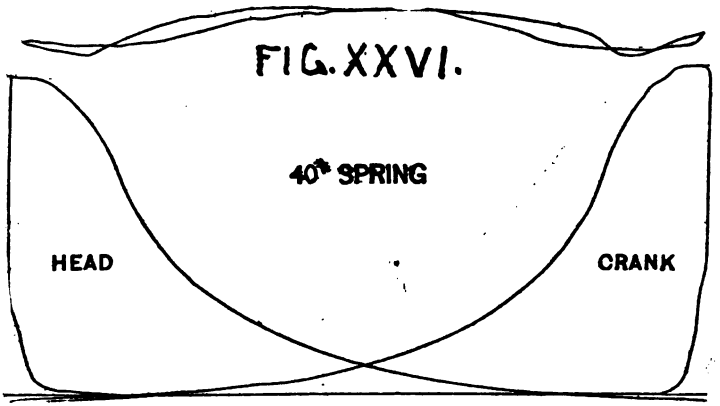
FIG. XXV.



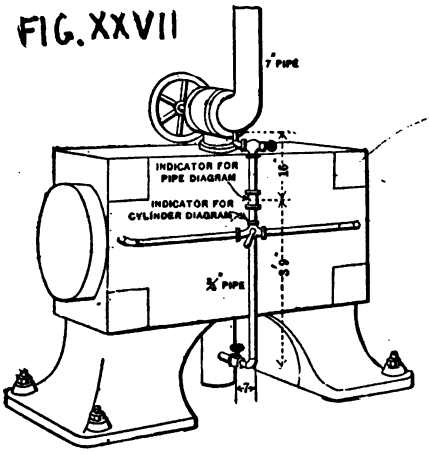
the higher speeds, everything else is all right on the high-speed light-load cards. The heavy-load cards using a larger amount of steam shows restriction in exhaust. Both exhaust and steam valves are either too small or not sufficiently opened.

Sizes of Steam Pipes and Chests.

Much that is interesting may be found by taking cards from both exhaust and steam pipes on the same sheet with the engine diagram. It will often appear that for the size of the pipe the steam chest is too small or the pipe itself too small to prevent a serious drop between the line pressure and the initial cylinder pressure. This will appear as a serious pressure change in the pipe. Fig. XXVI. shows the difference between pipe and initial. This card shows



both and in addition a drop in admission line. Fig. XXVII shows the piping. If the pipe had not been tested thus, drop might have been laid to too small ports.



Apparent Wire-drawing; Receiver Drop.

Fig. XXVIII. shows two sets of diagrams from a compound engine. The HP. cards shows real wire-drawing and the L. P. cards apparent wire-drawing. The fact is that the L. P. cards are drawing steam from a receiver of limited volume and suffer a considerable drop during admission, for during this period there is really expanding a volume of steam equal to the cylinder clearance and receiver volumes combined. A larger receiver would reduce this, but it is not serious and does not effect economy, as the real wire-drawing of the HP does.

FIG. XXVIII

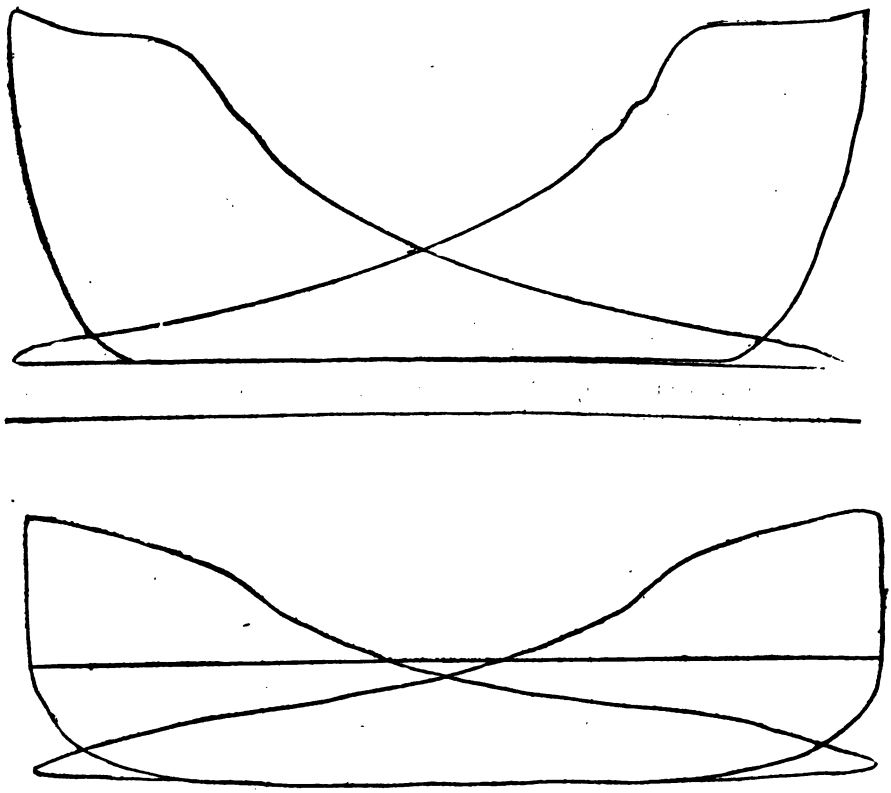
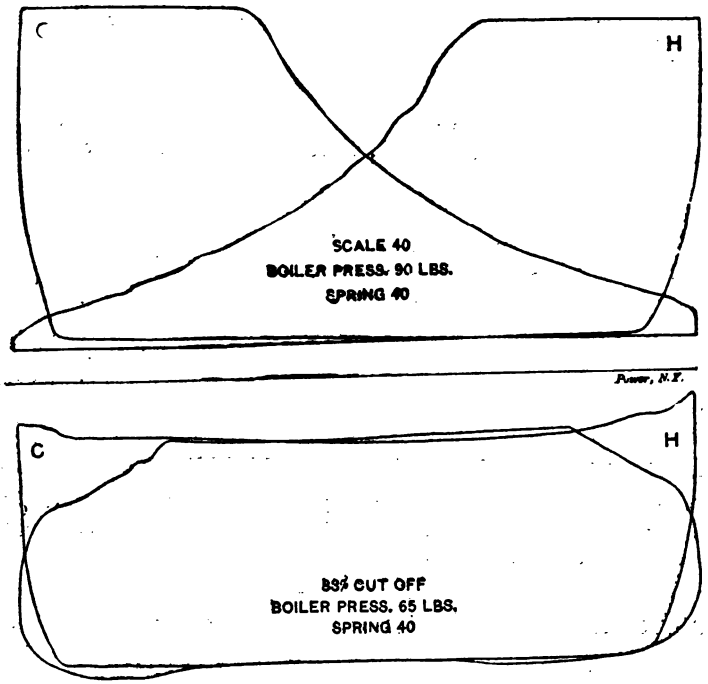
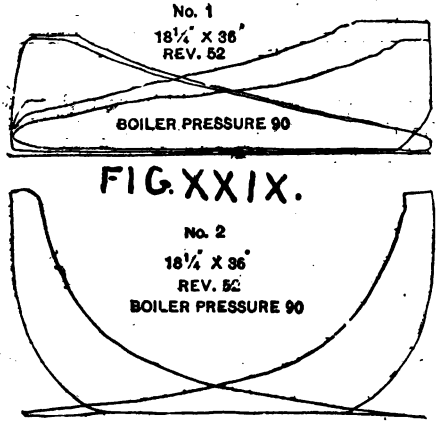


Fig. xxviii—Continued



Throttle Governor Action.

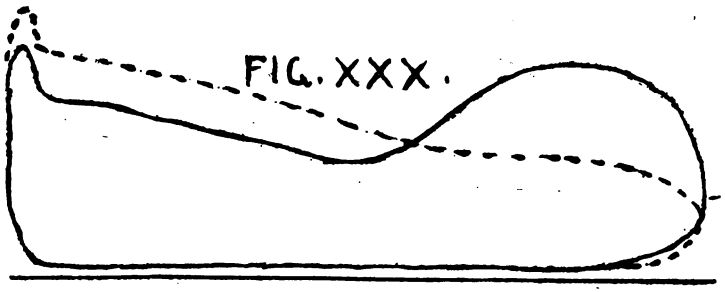
Fig. XXIX. at top shows a number of cards from an engine with a throttle governor; it will be seen that both initial pressure lowers and the expansion line



varies as the governor is apparently always on the point of reopening. This engine was afterwards fitted with automatic governor, and cards at bottom obtained showing better results.

Light Flywheel.

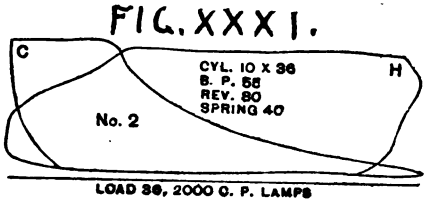
If after expansion begins on a throttle governed engine, load suddenly increases, the governor jerks open the valve. Fig. XXX shows a card on which



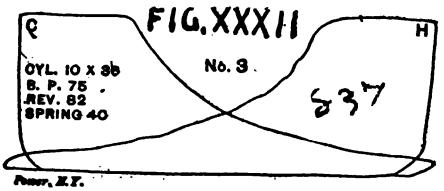
his happened. The revolutions were very constant for a given period but the rate of any one revolution varied badly, very much as does a hit and miss-governed steam engine.

Unequal End Work.—Not Wanted.

Fig. XXXI shows a pair of cards from an engine in which the two ends



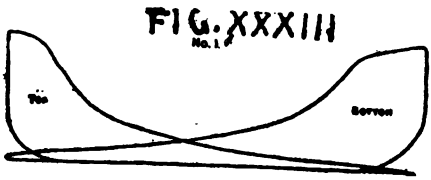
should be doing nearly equal work. It will be seen that one is doing very well for ecomony while the other is troubled chiefly by too long a steam line. Adjustment gave Fig. XXXII.



Final Card With New Valve.

Unequal End Work.—Wanted.

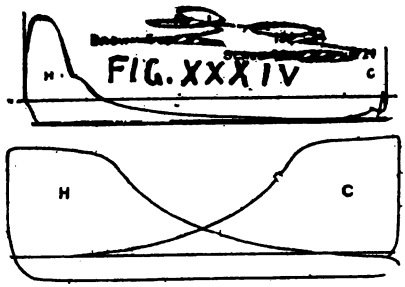
Vertical engines require a little more work in the crank end to balance the weight of the parts similarly more compression. Fig. XXXIII. shows such an adjustment properly made.



Single-acting air-compressor cylinders driven by double-acting steam cylinders require similar adjustment.

One Thing Wrong—Admission Valve.

Fig. XXXIV. shows a pair of cards before and after adjustment. It will be noticed that on the card which is out, the compression is all right, so it it safe to say, the exhaust-valve is all right, but the engine gets no steam on that

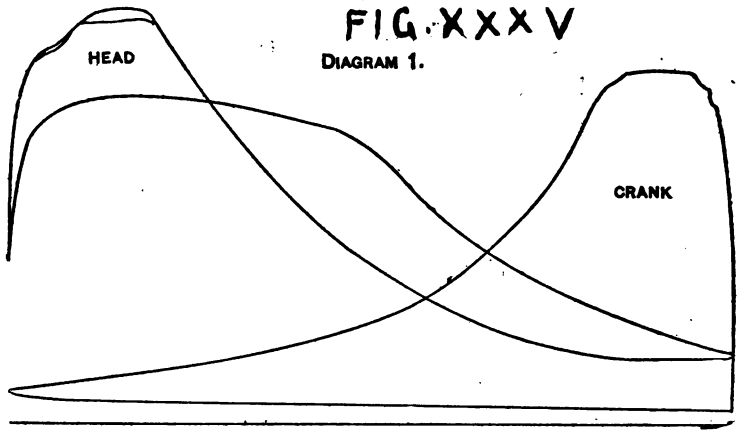


side, the other side is all right, so it certainly cannot be a slide valve engine, it must be a Corliss, on which the inlet valve of one side must be made to open.

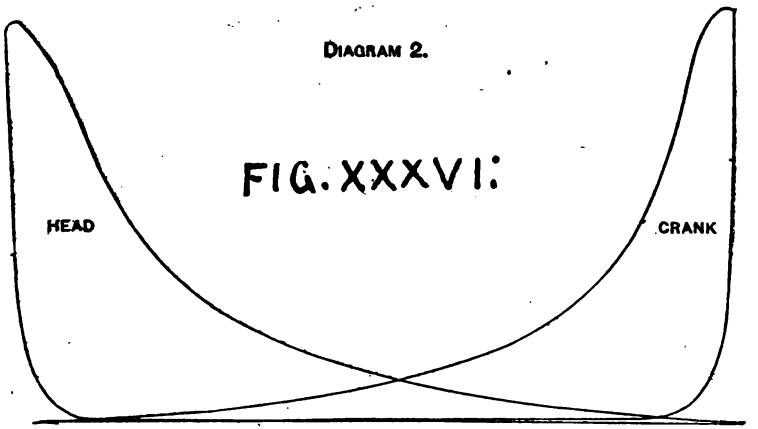
One Thing Wrong—Exhaust-Valve.

A pair of cards showing one end all right and the other end with perfect steam and expansion but with exhaust line very odd is shown. Fig. XXXV.

FIG. XXXV



It was found that the valve, a Corliss, was upside down. When fixed, the other set in Fig. XXXVI. was obtained.

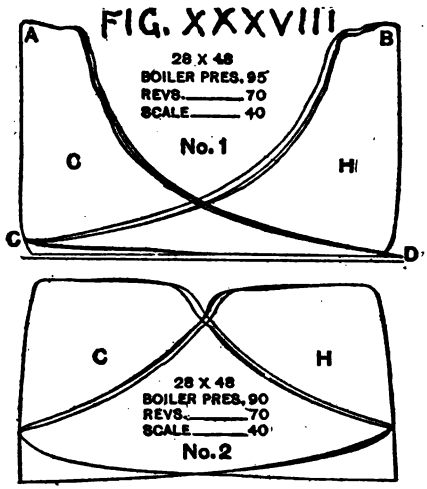


Same Thing Wrong—Both Ends.

Fig. XXXVII. shows another set in which cut-off is late on two sides and everything else all right. This is also a Corliss card and was adjusted without affecting the periods which are all right. The upper card is the one taken after adjustment.

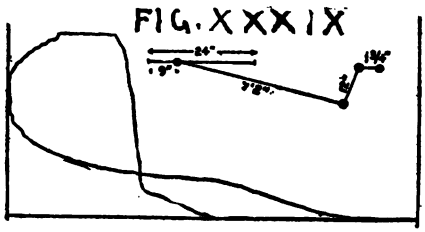
Everything Late.

A late admission A, a late cut-off B, a late release, C, and hence no compression D, is shown on card Fig. XXXVIII. This is a slide valve engine and was adjusted by turning the eccentric a little in advance.



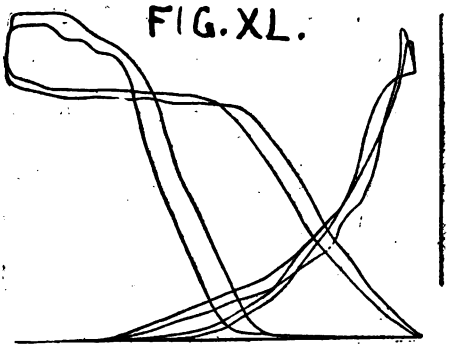
Freak Cards.

By attaching the reducing motion to the cut-off gear of a double-slide valve the card of Fig. XXXIX. was obtained, and with a little thought is as good as if taken with proper reducing motion. AB is the steam line; BC the admission



line; CD the expansion line; DEF the exhaust; FA the compression, and everything is as much displaced as the difference between the valve travel and that of the piston.

Fig. XL. shows a rather odd pair from a slide valve engine that can be analyzed



quite easily. On the left steam is cut off at A rather late and compression is early; the valve then does not get far enough to the left; it covers the port late on its left motion and covers it early on the rightward motion; it would seem as if the valve was always too far to the right. From the right-hand card it is clear the steam side never opens the exhaust opening for a time, and then compresses what steam entered from the exhaust pipe; this indicates the motion is too much to the right and means too short a valve rod, and verifies what is deduced from the left-hand card.

Mean Effective Pressure.

The mean effective pressure in steam practice depends on the steam pressure, the cut-off in per cent. and the compression, and the figures to be used in design have been determined by observation of the indicator card on a large number of engines of each class, and the figures given in various books on design were determined in this way.

Condenser Action.

The distribution of work in a compound-engine designed for a condenser

may be much upset by failure of the condenser to work. Fig. XLI. shows a

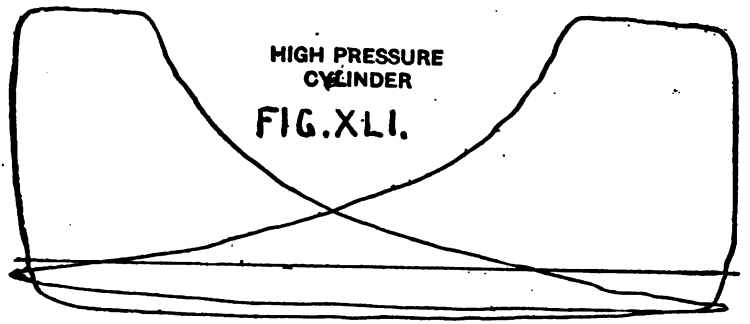
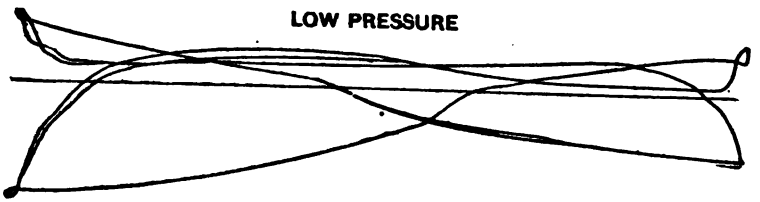
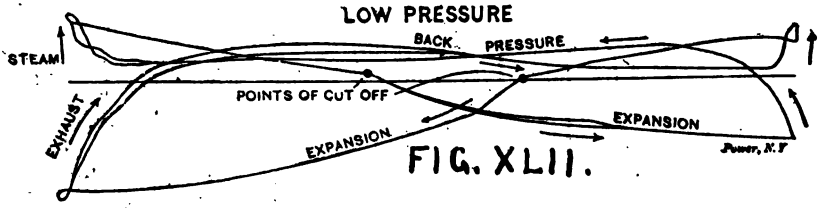


Diagram from the High Pressure Cylinder.



set of cards from HP and LP cylinders. It would appear at first glance as if from the low pressure card the valves were seriously wrong, but this is not so. First, the HP cylinder cuts off so early that not enough steam reaches the LP cylinder; and, second, the LP cylinder is doing negative work because the condenser is not working.

Fig. XLII. shows the periods marked, and they are about right; but on



exhausting instead of pressure falling to the vacuum it rises to a little above atmosphere.

Crank Effort and Engine Stresses.

In Fig. XLIII. let the circle represent the crank path; then if at any instant at point A a force F represented in intensity and direction by the

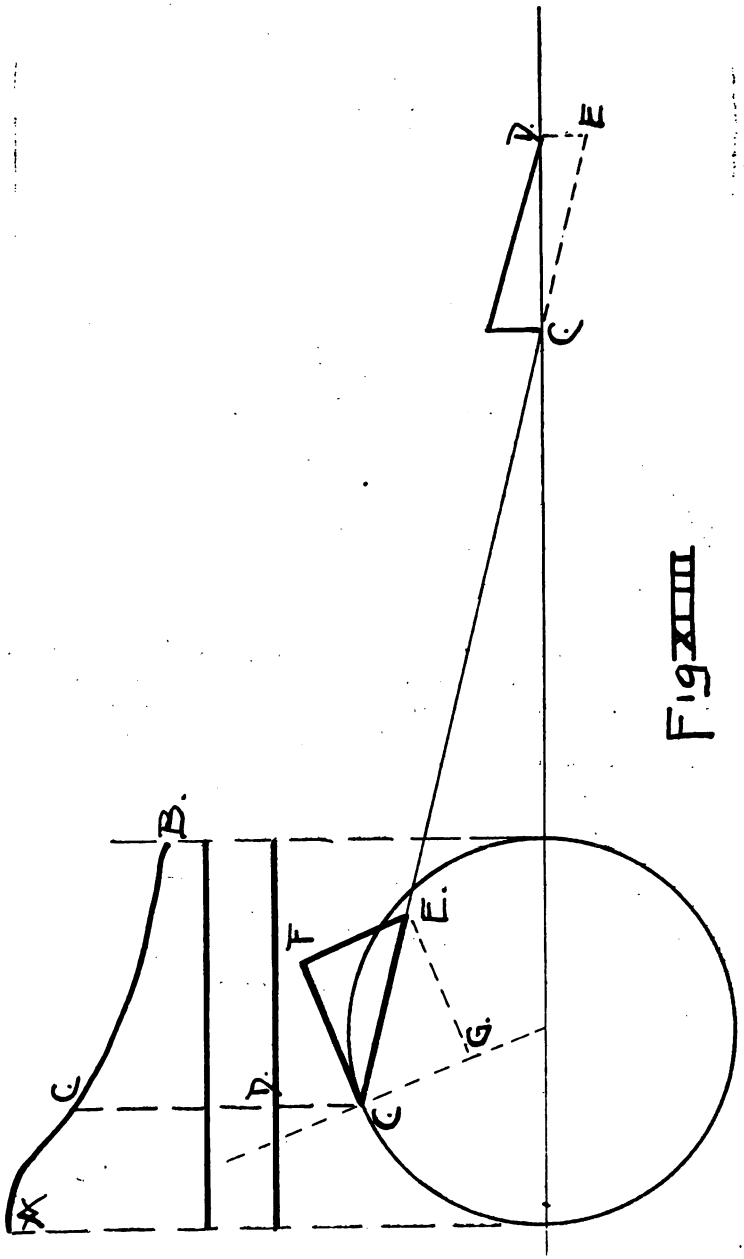
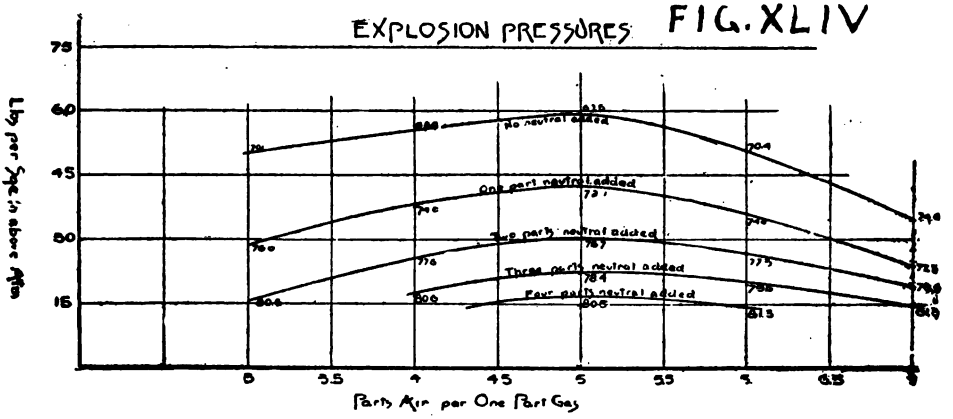


Fig XLIII

arrow act on the crank pin, the turning effort is found by the parallelogram one side tangent to circle and the other the crank radius produced. Then the force BA is resisted by the crank while force AC turns the shaft. At each instant the pressure on the piston varies as well as the angle between the crank and the connecting rod, but the varying force on the piston can be analyzed to find the varying tangential force on the crank for every point of the stroke. In Fig. XLIV. let AB be a steam and expansion line; there is acting a force propor-



tional to CD on the piston-rod. This may be analyzed into DE resisted by crosshead and EC acting along the connecting rod. Apply CE to the crank, then a part (CF) turns the shaft while a part (FE or CG) is resisted by the crank. If the turning force be found for every point of the stroke and the circumference stretched out in a straight line, we might draw a diagram showing the pressure at every point. Such a diagram is called the crank-effort diagram.

In a similar way we may get a diagram showing the force acting for every point of the stroke on main bearings, cross-head guides, engine-frames, etc. These are all stress diagrams due to mutual but varying forces on the pistons.

Summary.

It will appear from the preceding that the indicator may be used to determine useful data in steam work on the following questions:

The character of the expansion and its approach to ideal.

To some extent the condensation and re-evaporation.

Comparison of expansion of saturated and superheated steam.

Effects of steam jackets, cylinder lagging, etc. on expansion.

Effects of re-heater between cylinders of multiple expansion engines, on the expansion.

Mean-effective pressure for any set of conditions.

The indicated horsepower.

The friction of the engine by comparing B. H. P. and I. H. P.

The steam consumption approximately.

The comparative consumption for several cases of conditions.

Condenser action and effects of change in size of condenser.

Comparison of receiver *versus* no receiver.

Distribution of work in multiple expansion engines.

Best steam pressure and cut-off for multiple expansion engines.

Cylinder ratio for any pressure and cut-off for new designs of multiple expansion engines

Effects of change of condition on distribution of work in multiple cylinder engines.

Proper setting of valves for any desired result.

Value of any type of valve over another for any particular service.

Necessity for changes in design of valves.

Leaks under certain circumstances.

Proper and improper governor action.

Improper valve action due to faulty design or construction such as reopening, failure to close or too slow closure and opening.

Sizes of steam ports.

Sizes of steam and exhaust pipes,

Effects of clearance and change of clearance.

Stresses in piston-rod, cross-head, crank-pin, etc. for each point of stroke.

Variation of turning movement at different points of the stroke.

Gas Engine Work.

Pressures Due to Explosion

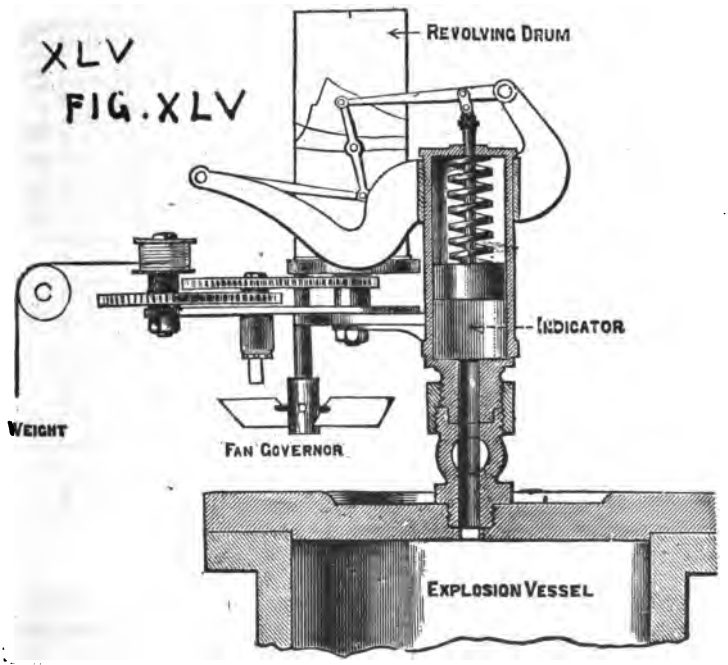
Mixture of air with gas or combustible vapor are explosive, and when confined in a space of constant volume and fired will cause a rapid rise in pressure in the enclosed gases. When fired behind a piston this rise in pressure will occur when the piston is on the center or moving slowly, but if the ignition take place when the piston is moving very fast the pressure may rise but little or not at all. The rise in pressure on firing is independent of how much mixture is present, but does depend on the kind of fuel, if the final pressure after explosion be denoted by p_2 and the atmosphere pressure before explosion be denoted by p_1, by enclosing the mixture in a chamber fitted with an indicator, the pressure line will be shown by a straight vertical line. If the drum be held still and different gases give the following values average:

Gas.	$p_2 - p_1$.
Producer	2 to 3
City water gas	3 to 4
Coal gas	4 to 5
Natural gas, gasolene, Kerosene	5 to 7

Diluting the mixtures continuously with more and more burnt gases decreases the pressure until finally the mixture will not light at all. All mixtures of air gases and burnt gases will have a certain pressure rise which can be found with the indicator. Fig. XLIV. shows a set of readings plotted in curves found by experiments by the author on N. Y. illuminating gas.

Time of Pressure Rise—Time of Hot Gas Cooling.

By slowly rotating the drum at some known rate the rising pressure will draw a curve and by continuing the rotation the cooling of the burnt gases will draw another line from which we can get an idea how fast the combustion proceeds and how fast the gases cool. Mr. Clerk did this and Fig. XLV shows his curves and Fig. XLVI methods mounting the indicator.



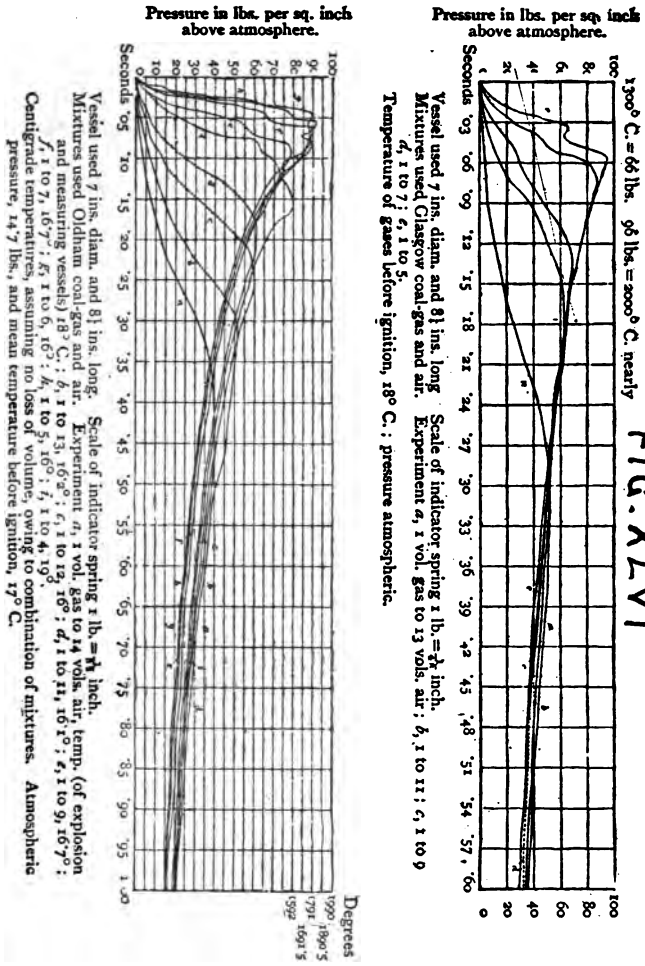

Pressure in lbs. per sq. inch above atmosphere.
1300° C. = 66 lbs. 96 lbs. = 2000° C. nearly
Seconds .03 .06 .09 .12 .15 .18 .21 .24 .27 .30 .33 .36 .39 .42 .45 .48 .51 .54 .57 .60
Vessel used 7 ins. diam. and 8½ ins. long. Scale of indicator spring 1 lb. = 1/11 inch.
Mixtures used (Glasgow coal-gas and air. Experiment a, 1 vol. gas to 13 vols. air; b, 1 to 11; c, 1 to 9
d, 1 to 7; e, 1 to 5.
Temperature of gases before ignition, 18° C.; pressure atmospheric.
Pressure in lbs. per sq. inch above atmosphere.
Seconds .05 .10 .15 .20 .25 .30 .35 .40 .45 .50 .55 .60 .65 .70 .75 .80 .85 .90 .95 1.00
Degrees
1990
1791
1592
1890°5
1691°5
Vessel used 7 ins. diam. and 8½ ins. long. Scale of indicator spring 1 lb. = 1/11 inch.
Mixtures used Oldham coal-gas and air. Experiment a, 1 vol. gas to 14 vols. air, temp. (of explosion and measuring vessels) 18° C.; b, 1 to 13, 16°2°; c, 1 to 12, 16°; d, 1 to 11, 16°1°; e, 1 to 9, 16°7°; f, 1 to 7, 16°7°; g, 1 to 6, 16°; h, 1 to 5, 16°; i, 1 to 4, 19°.
Centigrade temperatures, assuming no loss of volume, owing to combination of mixtures. Atmospheric pressure, 14·7 lbs., and mean temperature before ignition, 17° C.

FIG. XLVI

When compressed before ignition the gases burn very much faster and the pressure ratio p2-p1 is not so great; this is what takes place in the gas engine cylinders. A mixture is drawn in by suction through poppet valves, is compressed into a clearance space or combustion chamber and there fired, the increased pressure drives the piston out, exhaust follows and the fly-wheel does the rest. There are two methods of bringing about this cycle of operation now in use.

The four stroke cycle has both inlet and exhaust valves fitted (Fig.

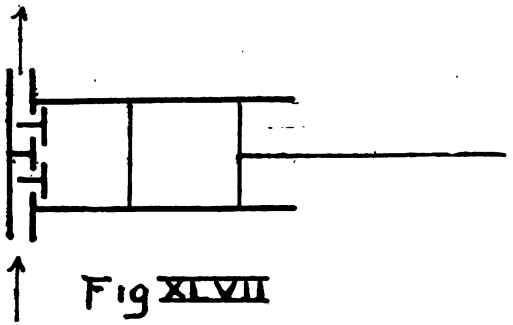


Fig XLVII

XLVII) and there take place on each stroke the following:

First out stroke	Suction of Mixture
On center	Suction valve closes
First in stroke	Compression of Mixture
On center	Explosion of Mixture
Second out stroke	Expansion of Mixture
On center	Exhaust Valve opens
Second in stroke	Exhaust
On center	Exhaust Valve closes and Suction Valve opens.

In practice the exhaust valve opens a little before the out center. If there were no obstructions in inlet or exhaust the card would appear like Fig. XLVIII.

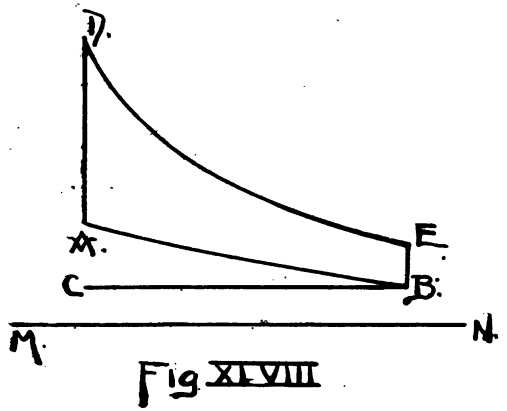


Fig XLVIII

M N is the perfect vacuum line.
BC the atmospheric line and the operations are:
Admission C to B.
Compression B to A.
Explosion A to D.
Expansion D to E.
Exhaust E B C,

The two stroke cycle has no valves except a suction check on the crank case, Fig. XLIX., but ports are cut in the cylinder wall near the out center

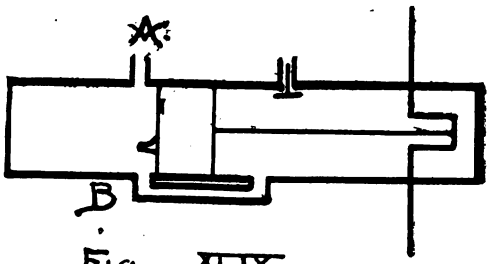


Fig. XLIX

position of the piston, A the exhaust is uncovered first and B, the inlet, is uncovered immediately after permitting mixture that was stored in crank case at a slight pr. (5 lbs.) to pass up to the cylinder, strike the deflecting plate and partially clear out the burnt gases. These operations occur, every out stroke being the same and every in stroke also.

	Cylinder	Crank Case
In	Main Compression A B	Suction of fresh mixture X Y
Center	Explosion B C	Suction valve closes, Y
Out	Expansion C D	Preliminary compression, Y Z
Near Center	Exhaust and Inlet open D E A	Mixture passes to cylinder Z W X

If there were no resistance the card should appear like Fig. L.

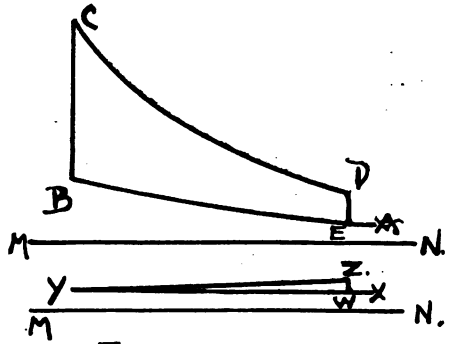


Fig. L

Obstruction in Suction.

To determine the character of the suction line a light spring may be attached and fitted with a stop so that it cannot compress too much, the igniter is thrown out temporarily. Fig. LI shows a card taken in this way from

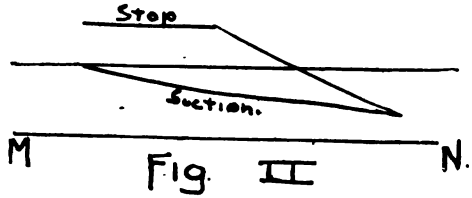


Fig. LI

a four cycle engine and Fig. LII. are from the crank card of a two cycle engine. While Fig. LIII. shows the alteration on the complete four cycle, the card of the two cycle is unaltered.

Fig. LII

Obstruction in Exhaust.

A little skill will enable the low scale spring to be thrown in during the exhaust and suction stroke and out where gas is exploding and expanding, an explosion acting on the weak spring with a stop will break the indicator. No indication of an obstructed exhaust can be found on the two cycle card from the cylinder except a rounding out of the end and by the lowered explosion pressure due to the large amount of burnt gas retained, Fig. LIII. The little rise on the line of the crank case card, Fig. LIV. shows how the exhaust first

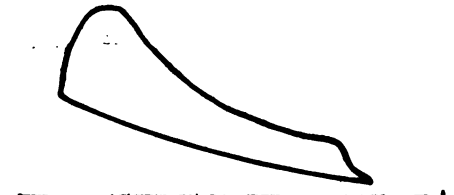


Fig LIII

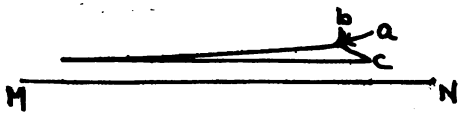


Fig LIV

entered the crank case before fresh gas could enter cylinder; this generally causes an explosion in crank case and stops the engine.

The four cycle card shows plainly the result of exhaust obstruction, the exhaust line being nearly the whole stroke above atmosphere. Fig. LV. shows both suction and exhaust obstruction effects.

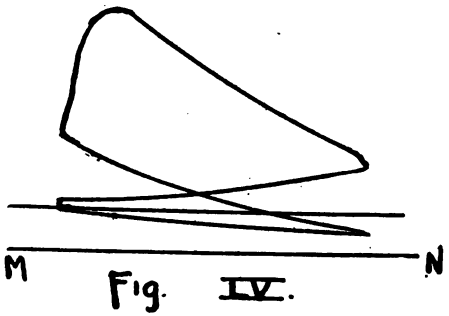
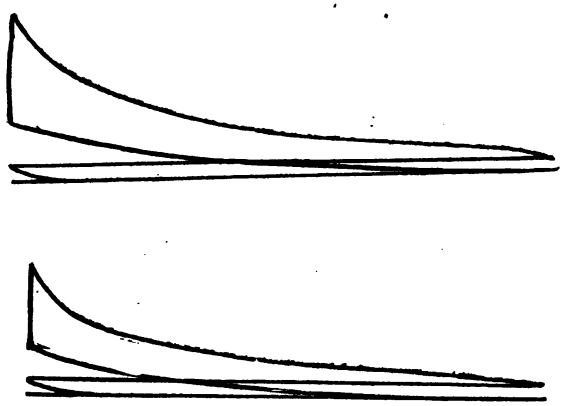


Fig. LV.

Effects of Back Pressure.

By obstructing intentionally the exhaust, the effects of back pressure may be observed, a two cycle engine will stop at once with the treatment, but a four cycle engine will take in decreasing fresh charges to run with the increasing amounts of burnt gases retained so that not only will back pressure resistance be introduced but also the explosion will become weaker and the rate of combustion slower, making it impossible for the pressure to keep up with the piston motion. Fig. LVI shows a set with this effect.

Fig. LVI



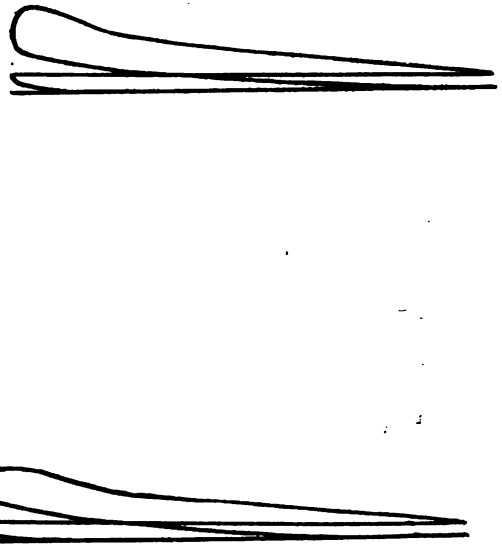
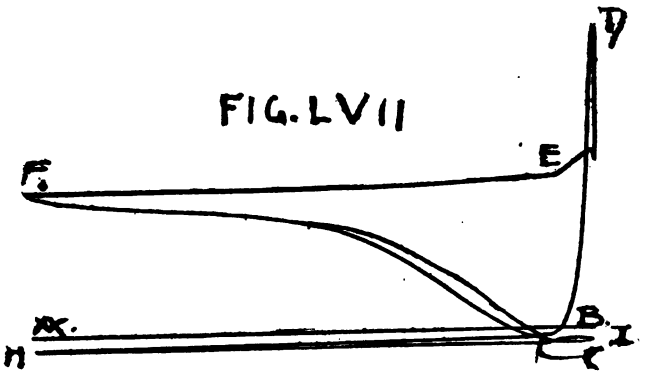


Fig. LVI

CONTINUED

Exhaust Pipe and Muffler Action.

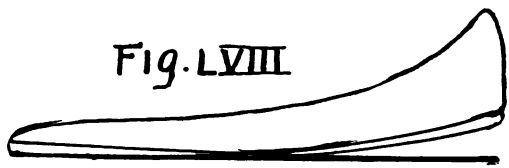
Fig. LVII shows a card taken on the exhaust pipe of a gas engine, AB is the atmospheric line, exhaust valve opened at C causing the sudden rise CD



which soon dropped to E when the piston began to return during this stroke the pressure was fairly constant EF, at F the exhaust valve closes and pressure falls from the double effect of escape to roof and cooling in the pipe, this cooling actually causes a partial vacuum HI during the next stroke. Much valuable information concerning the sizes and action of exhaust pipes and mufflers can be obtained in this way.

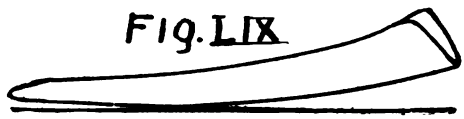
Leaks.

If there are any leaks in the valves, packing or piston they are readily detected by taking a card with igniter thrown out. The expansion line, if there are leaks, will fall below the compression line. Fig. LVIII shows this and also a card with full explosion.



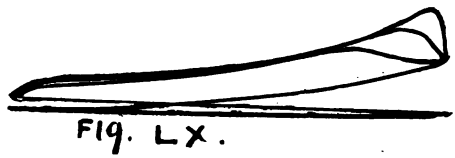
Scavenging.

Some gas engines govern by cutting out an explosion, entirely permitting air alone to be compressed and discharged so that just after a miss the mixture consists of air, gas and air while just after explosion it consists of air, gas and burnt gas. Fig. LIX shows a card on which this is occurring.



Mixture Variations.

Changes in the mixture change the ratio of combustion and if the piston speed remain constant the explosion line will become flatter and flatter, everything else remaining constant. Fig. LX shows a set taken by manipulating the gas valve.



Variation of Ignition.

By changing the point of the stroke at which the mixture is fired we get widely differing areas. Fig. LXI shows a set from the same engine, while

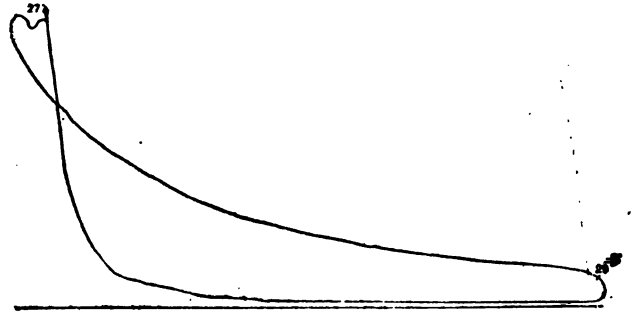


FIG. 3. IGNITION, + $4^{19}/_{32}$"

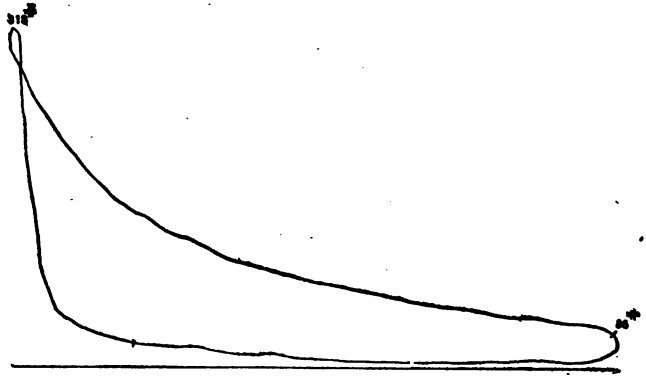


FIG. 4. IGNITION, + $2^1/_8$

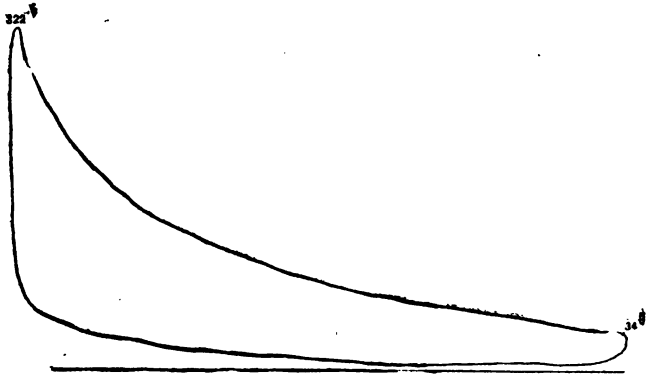


FIG. 5. IGNITION, + $1^1/_2$

Fig. LXI.

Figure LXI.—Continued

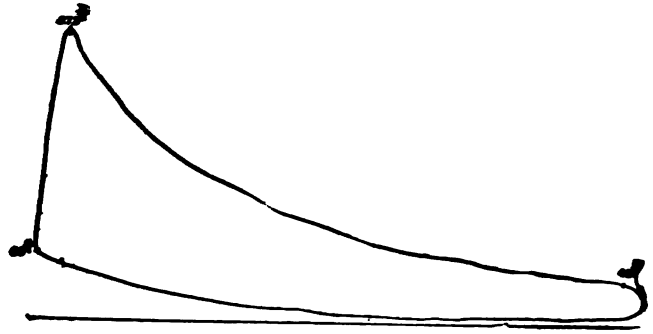


FIG. 6. IGNITION, $+\frac{1}{8}$

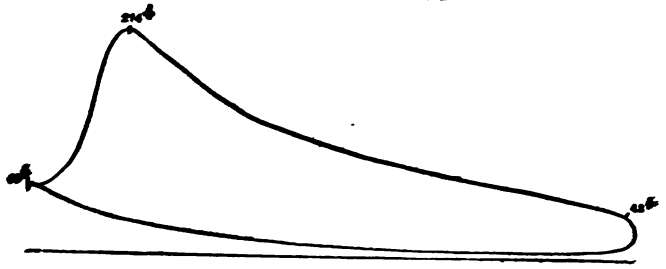


FIG. 7. IGNITION, ± 0

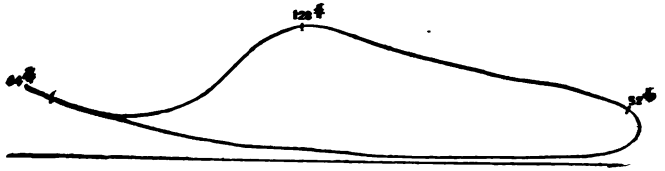


FIG. 8. IGNITION, $-\frac{1}{8}$

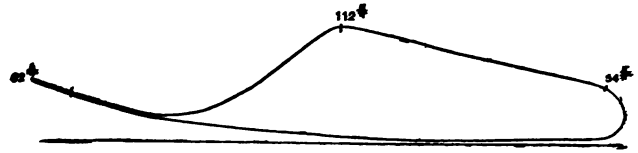


FIG. 9. IGNITION, -1

Fig. LXI—Continued

FIG. 10. IGNITION. – 1½

FIG. 11. IGNITION. – 2

Fig. LXII shows a set from another engine with leaky piston; there are no preignitions on this set.

Fig. LXII

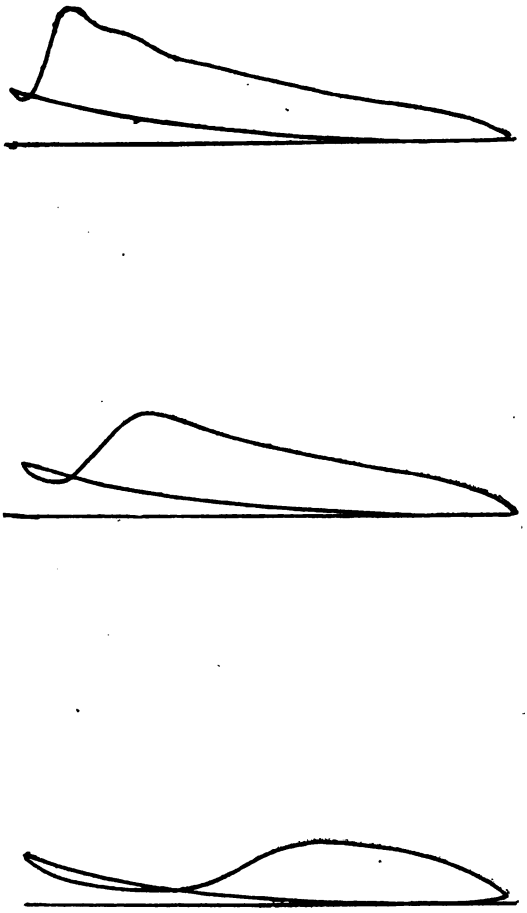


Fig. LXII

Continued

Abnormal Action. Explosion Wave.

Under certain circumstances there is found in gas engines a violent thumping on ignition and if at the time cards be taken they will be found to show a distinct wave of large amplitude. This is not due to spring action but

to a real wave such as occurs in attempting to transmit an impulse through elastic medium, the layer next the impact is first compressed then the next while the first expands, so a wave of pressure is sent through the mass. These waves are found most in quick burning mixtures such as gasolene with air or in slow mixtures rendered quick by high compression especially when the explosion chamber is not of simple form but contain pockets. Fig. XLIII shows one of these waves.

Mean Effective Pressure.

It is found that the mean effective pressure increases for any given fuel with increase of compression, but is practically the same in all engines using same compression and same fuel. The compression in use in pounds per square inch with average MEP above atmosphere are as follows for average medium speed engines:

	Comp.	MEP
Furnace gas	160 pounds	70 pounds
Producer gas	130 "	80 "
City gas	90 "	90 "
Gasolene and kerosene	50 "	100 "

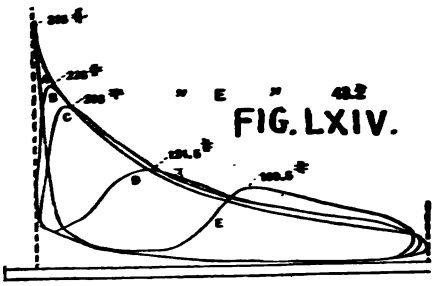
These figures are useful in designing new engines, but, of course, must be used by one who understands the various circumstances of detail that may cause alterations.

Governor Action.

Each of the different methods of governing gas engines may be investigated by the indicator. These may be grouped into three classes.

1st. Explosion cut-out. This does not affect the card except by the scavenging effect already noticed.

2nd. By varying the point of ignition. Fig. LXIV shows a set giving results from no load to full load.



3rd. By throttling the mixture, decreasing the amount admitted. Fig. XLV shows such a set.

Gas Pipes Too Small.

Very often the explosion line of an otherwise good card seems very short and the engine under power, the first thing to do in this case is to put a weak spring indicator on the gas pipe and then in the air duct, if much drop in pressure is observed and if it occur suddenly these pipes are too small.

Summary.

In gas engine work the following questions may be classified by use of the indicator:

Pressure due to different mixture of air and gas.
Pressure due to different mixture of air, gas and burnt gas.
Time to reach maximum pressure or rate of combustion.
Time to cool to original pressure or rate of cooling.
Detection of exhaust obstruction.
Proper sizes of exhaust valves.
Proper adjustment of the engine.
Proper point of ignition and effects of variation of ignition.
Best mixture and effect of variation of mixture
Muffler and exhaust pipe action.
Effects of back pressure.
Detection of leaks even when small.
Sizes of gas and air ducts.
Governor action good and bad and comparison of methods.
Mean effective pressure for different compression.

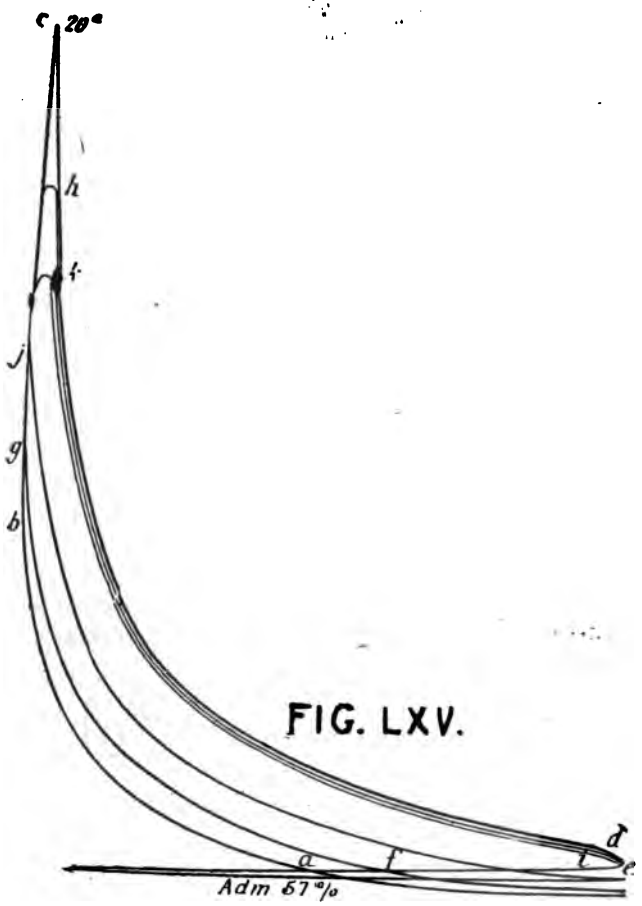


FIG. LXV.

Mean effective pressure for different fuels.
Maximum compression for any fuel without pre-igniting.
Maximum pressure in cylinder.
Pressure existing at exhaust; stress on exhaust valve for designing gear.
Abnormal actions; Explosive wave.
Relation between piston speed and rate of combustion.
Stresses in all the parts at every point of stroke.
Variation of turning moment at every point of stroke.

Air Compressor.

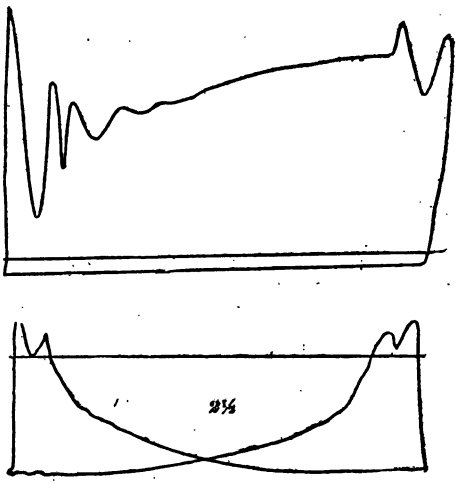
After what has been said on steam and gas engines the service of the indicator on air compressor work will be apparent, a few of the simple problems are mentioned:

Sizes of suction inlets.
Kind and size of suction valves.
Character of compression curve.
Action of delivery valves.
Obstructions in inlet and discharge.
Effects of speed on suction and discharge.
Comparison of receivers for size and sizes of delivery pipes.
Difference of size of receiver on second and third stage of compression.
Improperly working valves.
Leaks.
Effects of clearance.
Stresses in parts.
Distribution of work in multiple stage compression.

Pump's Water End.

Sizes of ports and pipes.
Presence of air trapped in cylinder.
Valve resistance.

Inertia of suction, Fig. LXVI. shows card with and without suction air-chamber in which the effect of inertia of the water appears, Fig. 2 shows the



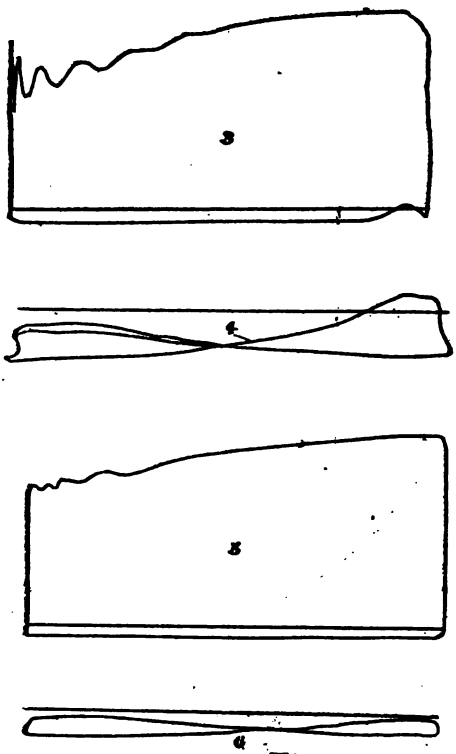


FIG. LXVI.

cylinder card, Fig. 2½ the suction pipe card, Fig. 3 and 4 the same with air chamber in one position and Fig. 5 with the air chamber as located finally.

Valve leaks (Fig. LXVII) shows a card in which appears evidence of a leaky suction valve. At B appears evidence of inertia of discharging column

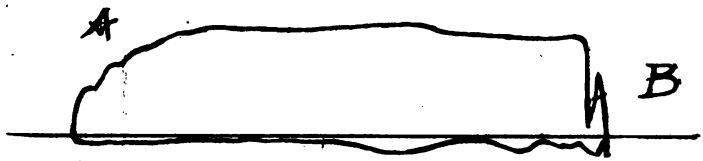
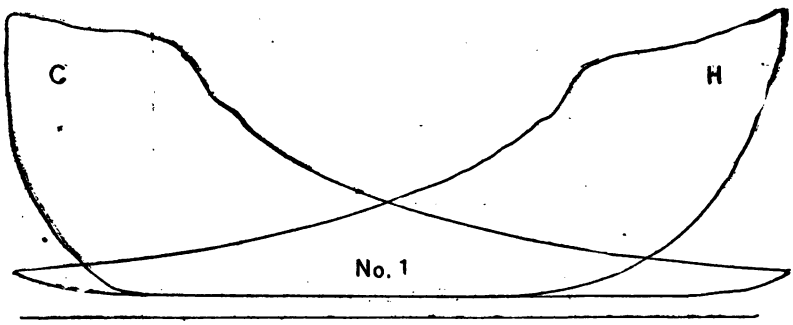


FIG. LXVII.

which continued to move fast as piston slowed down causing the pressure variation.



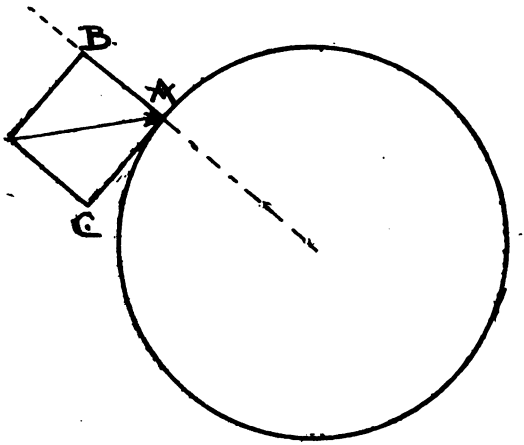


Fig XLVI

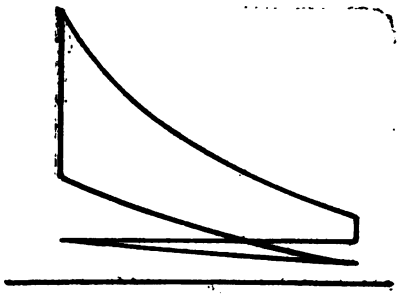


Fig. XLVII

MR. POMEROY :—I would like to ask Dr. Lucke whether certain effects, or, rather, varying degrees of compression, due to different qualities of gas, can be discerned by the indicator. Take, for example, (a) natural gas of 1,000 B. T. U., (b) blast furnace of 95 to 100 B. T. U.

DR. LUCKE :—It is found in gas-engine work and can be shown theoretically that it should be so that the amount of work which we can get from a certain amount of gas increases as we increase the compression before firing. The higher we compress before firing the more work we can get from that same amount of gas. With weak gas, such as blast-furnace gas of 95 or producer gas of 130 B. T. U., we can compress very high before igniting and we can thus get a better account of our B. T. U.'s than we can with gases which do not permit of high compression. Gasoline, for example, will not permit safely, in large cylinders, of over 50 pounds, and sometimes 40 pounds gives trouble. Blast-furnace gas can go higher, as high as 160. On the test that I mention, the one on which I worked week before last, producer gas of 130 was used ; the compression was 140 to the square inch. When I say producer gas of 130 I mean gas will give 130 B. T. U.'s to the cubic foot. On construction this can be compressed to 140 pounds per square inch before firing. We therefore got in that case a larger percentage of the heat of the gas turned into work than we could get in the case of the richer gases. This is a very peculiar thing and is only brought out by such work as this. Does that answer your question ?

MR. POMEROY :—Certainly. That was the point I had in mind. And this suggests another question, viz., with large units, say of 1,500 horse-power and over, is it not a fact, from the standpoint of safety, that better results are being reached with gas of poor quality, that is to say, of 100 B. T. U., than with the richer or natural gas ; in other words, is it not more dangerous to attempt great compression with the richer gas ?

DR. LUCKE :—Yes, they are, but that introduces another element that has not been very much discussed in the published reports of these engines. That is, the explosive wave affair. By highly compressing gas, if even very poor gas, before firing, the wave is always

introduced. On this 140 pound compression gas we had a very high wave. The engine just fairly shook like that (indicating) every time the charge ignited. That is explained by the fact that the rate of propagation seems to be increased with compression. That is, gas burns faster if it is compressed high before lighted, even though the gas is very poor in heat units. So that while we get in large engines a greater account of the work done, greater economy in working with weak gas than with rich gas, still I think the engines give a little bit more trouble than they ought to on the high compression. I know one case where the crank shaft was designed by a perfectly intelligent man. who knew his business and designed lots of them, yet the conditions, somehow or other, got so piled up, one seemed to help the other, that it bent every time it fired and you could see the flywheels wobble this way (indicating) with the bend. That was due chiefly to the high compression before firing and was due to the introduction of poor gases.

MR. POMEROY:—I do not desire to occupy too much of your valuable time, but I am getting information on a subject of interest to me, and this moves me to say that there is a rumor afloat that the limits of economy with the large sizes of gas engines working with natural gas have been reached on account of the danger in attempting a degree of great compression, and I could not reconcile this rumor with the report that the Snow people of this city were building engines for the Standard Oil Company of 1,500 to 2,000 horse-power for compressing natural gas, thereby raising the pressure of the gas to facilitate transmission over long distances.

DR. LUCKE:—Yes, I should not be afraid to risk that at all because there is always the alternative of piping a little exhaust around and blowing it into the suction; you can then reduce the gas as much as you please. I think that would be a rather nice experiment. I would like to take part in it. You see you can reduce the quality of the gas very easily that way if it should prove dangerous. I do not believe it will, though.

MR. POMEROY:—I mean the compression.

DR. LUCKE:—Yes, the compression; by impoverishing the gas

you make it possible to compress without pre-ignition to a higher degree.

MR. POMEROY :—Is it not a fact that with the Korting gas engines for the Lackawanna Iron & Steel Company, they are deliberately calculating on a high degree of compression, and is not this high compression one of the strong, taking points, commercially, claimed for this type ?

DR. LUCKE :—Yes, and they govern by impoverishing.

MR WEST :—I understood Dr. Lucke to say that it was desirable to explode the gas between nine-tenths of a stroke and the full stroke and yet it is hard on the engine. Is that correct ?

DR. LUCKE :—Yes, in the main it is. That also depends on circumstances. I perhaps should not have made quite so general a statement. Of course, the exact point at which you should fire depends upon what is called the rate of propagation of inflammation through the mixture. This means on how fast the mixture burns. If you have a quick-burning mixture it is not necessary to pre-ignite so far in the stroke as if you have a slow-burning mixture, because the time to reach the maximum pressure in one case is less than the other. In most city gas, water gas, you will find that the figure is right.

MR. WEST :—It is directly opposite with a locomotive, valve set with lead.

DR. LUCKE :—Yes.

MR. POMEROY :—Doctor, do you use identically the same type of indicator for gas engines as with steam ?

DR. LUCKE :—I perhaps should have mentioned that. We use the same type of indicator but with two changes ; the steam indicators all have pistons with a half-square-inch area. The one we use on gas-engine work has a quarter-square-inch area and a liner is put in the cylinder and in addition a heavier arm added.

MR. POMEROY :—Do you mean bushing ?

DR. LUCKE—Yes. It is made by the indicator company. We use the same spring, but by reducing the area of the piston stroke we naturally double the scale of the spring so that a 120-pound spring acts as 240, and on all city gas work 120 is what I have used. It is the safest one because pressure going up to about 350 pounds will be recorded.

MR. MURRAY:—There is one question I would like to ask. In this gas engine do you always introduce air with the gas to explode it?

DR. LUCKE.—Yes; that is necessary. Not only is that necessary but the exact proportion is also a necessity.

MR. MURRAY:—Yes, that is what I understood. Now, by compressing gas will that make it more dangerous to handle? As I understand it, compressed gas in combination with air is more explosive.

DR. LUCKE:—That depends on just what you mean by more explosive. If you mean it is easier to ignite, it is.

MR. MURRAY:—More dangerous to handle.

DR. LUCKE:—Only because this is true; pressure ratio during explosion is about constant. (Explains by a drawing on blackboard.) That is why it is more dangerous. It will do more bursting.

MR. POMEROY:—Does this hold good in all internal combustion engines?

DR. LUCKE:—Oh, yes, whether worked by gasolene. kerosene, alcohol or mixtures of those, because what does the work on the gas is not the liquid but the vapor of the liquid mixed with air. The vapor alone unmixed with air is perfectly harmless. Therefore there has to be a gaseous mixture and therefore all the properties of gaseous mixtures are applicable to oil vapor or other combustible vapor and air.

MR. POMEROY:—It is stated that with acetylene gas the great danger lies in attempting to compress it, thereby changing its relation

to the atmosphere. In this connection I would like to ask if acetylene gas has been used in gas engines.

DR. LUCKE:—Very little. The man that tried it had trouble. The main trouble with acetylene is its instability. It is an unstable gas. It tends to decompose within itself from sometimes apparently no reason at all, aside from its explosive property when mixed with air. All gases will explode when properly mixed with air, but acetylene will explode without any mixture of air. That would be very handy if you could do it when you wanted to, but it always happens when you do not want it.

MR. MURRAY:—I would like to ask another question: When do you mix this gas with air; before you put it into the cylinder?

DR. LUCKE:—On the suction stroke, yes.

MR. MURRAY:—Just before you put it into the cylinder?

DR. LUCKE:—Yes; on the suction.

MR. MURRAY:—You have a mixing cylinder? You can plainly see I don't know much about the gas engine.

DR. LUCKE:—Not to amount to anything; it isn't necessary. Let me draw a cylinder. (Indicates by a drawing.)

THE VICE-PRESIDENT:—I would like to ask the Doctor one question; perhaps he can give me the information: What proportion of the length of the cylinder is left for compression space as a rule?

DR. LUCKE:—You may easily compute that to your own satisfaction in any particular case, from a formula; it varies from a third to a quarter in most cases; that is with ordinary city gas; but in cases where you had a weak gas, such as blast-furnace gas, the pressure that is wanted is higher; in any case the pressure is determined by the volume of the clearance space. (Explains formula on blackboard.)

THE VICE-PRESIDENT:—Is there any further discussion on the subject? Would any member like to ask any further questions?

MR. MURRAY:—I would like to ask one more question, if I may: There have been several kinds of gases mentioned and among the

others acetylene. Is that the most explosive gas commercially used ?

DR. LUCKE :—There again we must have a definition. "Most explosive gas" may mean a whole lot of things. Acetylene, as I said, has a tendency at times to decompose within itself for uncertain cause. When mixed with air it will also cause what we might call normal explosions. Now, the highest pressure which results from an explosion of mixed air and gas is obtained when the weights have a certain ratio, weights necessary for combustion, etc.—leading me into a whole lot of mathematics. Shall I go on, or shall I cut it out?

MR. MOONEY :—Well, acetylene is not commercially used with gas engines, is it ?

DR. LUCKE :—No ; too expensive.

MR. MOONEY :—Cut it right out if it is not for commercial use.

DR. LUCKE :—But the question of what is the best gas—I suppose that is what was in your mind, was it not ? What would give the greatest effect ? A whole lot of things go into that. I could write a whole book on that, I think.

MR. MELLON :—In gas engines of large capacity, say 500 horse-power, do manufacturers provide any means for getting the first stroke, which in small engines has to be done manually ?

DR. LUCKE :—Usually the builders provide a compressed-air chamber which may be initially filled either by hand pumps or by any other pumping machinery which may be handy ; and it is supposed that the engineer in charge of the operation will see that the chamber is well filled up before he shuts down his engine on another run. Just how that is going to work in any individual case depends upon circumstances.

MR. MOONEY :—Doctor, you spoke about compressed air and losses of pressure in pipes due to heat. Is it due to the heat of compression or the shrinkage of the air in cooling ?

DR. LUCKE :—The air has its temperature raised by the compression alone and the shrinkage is directly traceable to the inability

to take the heat of compression out during the compression; they are independent.

MR. MOONEY:—The loss of pressure could also be traced to small pipes or improper size, could it not?

DR. LUCKE:—Yes; you can easily tell which that is, in any particular case by putting your indicator on and putting thermometers in, too. If you notice a drop in temperature you can compute exactly what ought to be the decrease in volume. (Indicates on blackboard.)

THE VICE-PRESIDENT:—Is there anything further?

MR. SUMNER:—To go back a minute to the steam engine indicator rigging: I don't quite understand the criticism of the plain lower reducing motion. I think you said it was rather inaccurate?

DR. LUCKE:—Yes.

MR. SUMNER:—Isn't the inaccuracy of the sliding motion of the lower portion of the arm compensated by the slide in the arm where connection is made to the indicator?

DR. LUCKE:—In most cases it is not. I will show you, first, a case in which it is and then another in which it is not. It will very clearly come out. Professor Burstall, of the gas engine research committee of the British Institute of Mechanical Engineers, used this reducing motion, which was a proper pendulum motion (indicates on board), and by comparing with the other which I said was improper the impropriety of the latter readily appears.

MR. SUMNER:—You understand what I referred to was the level shown in the second sketch there, with a slot as well for indicator motion rod.

DR. LUCKE:—Oh, yes; I guess that is right.

MR. SUMNER:—Nobody would attempt to use that other one.

DR. LUCKE:—They do; you see lots of them.

MR. MOONEY:—Mr. President, as this is a very important subject, I move it be closed for the time being and carried over for future discussion.

THE VICE-PRESIDENT :—The Doctor has said to the Secretary and myself that if there are any points or questions in this discussion that he will answer them by correspondence with the members of the Club through our Secretary ; or, he will come here at our next meeting if the members desire.

MR. MOONEY :—We would like to have the Doctor come again.

MR. POMEROY :—Good fellow.

THE VICE-PRESIDENT :—I believe we have all been benefitted by this discussion, learned something we didn't know and have been helped concerning some matters in which we were weak. I believe it would be for the best interests of the Club to have the Doctor meet with us again.

MR. MOONEY :—And I so make that motion, too.

THE VICE-PRESIDENT :—And continue the discussion to that time. Is the motion seconded ?

MR. WEST :—I second the motion.

THE VICE-PRESIDENT :—It is moved that the discussion be carried over until our next meeting and that Dr. Lucke be asked to be with us at that time. Carried.

MR. MOONEY :—I now move that the thanks of this Club be extended to Dr. Lucke for the very able paper and enlightening discussion.

MR. POMEROY :—I would like to offer as an amendment that the vote be made a rising vote.

THE VICE-PRESIDENT :—Do you accept the amendment ?

MR. MOONEY :—Certainly.

MR. WEST :—Yes.

THE VICE-PRESIDENT :—And that a rising vote be taken. Those

favoring the vote of thanks to Dr. Lucke will please rise. (Unanimously carried.)

THE SECRETARY:—Mr. President, the Secretary would like to say in this connection that it is very gratifying indeed to find the members so appreciative of what has been given to them for their instruction and entertainment here this afternoon. If plans under way can be carried out, this is but a beginning of the Central Railway Club receiving recognition of value by men of the character, ability and learning of Dr. Lucke during the ensuing year, and establishing a record for individual papers not excelled by any other railroad club in this country.

THE VICE-PRESIDENT:—We will close that order of business. Is there any other business?

THE SECRETARY:—There is no other business, Mr. President, except as called for by the schedule.

ELECTION OF OFFICERS.

THE VICE-PRESIDENT:—The next order of business will be the election of officers. Under a recently adopted amendment to the Constitution officers will be nominated from the floor—that is from those present. The Secretary will therefore now receive nominations for the office of President. We elect a President, Vice-President and four members of the Executive Committee.

Mr. Rosevear then nominated for President Mr. George W. West.

Mr. Miller seconded the nomination.

MR. MOONEY:—I move that Mr. West be elected President of this Club by acclamation.

MR. WEST:—Gentlemen, we went to a great deal of thought and have given this matter a great deal of attention, and while I should feel highly complimented by such a vote I would much prefer that a second nomination be made and that we adhere strictly to the Constitution. I think that the welfare of the club demands that. There

has been a little feeling here which I think has been growing for two or three years and we want to eliminate that from this Club. I believe we can have one of the best clubs in the country if we can agree on its officers, and I hope that whatever choice is made to-day that the minority will abide by it and turn in and help us, so we can make the Central Railway Club not the third nor fourth but the first railroad club in this country, and I would much prefer that a second nomination be made and that we proceed to elect the officers by ballot.

MR. POMEROY :—If I am in order I would move that the nomina tions be closed.

THE VICE-PRESIDENT :—The way to close nominations is not to make any more.

MR. MILLER :—I would move you that the Secretary be authorized to cast the ballot for the election of Mr. George W. West to serve as President for the coming year.

MR. MOONEY —I second the nomination. Carried.

THE VICE-PRESIDENT :—I will appoint Mr. Turner and Mr. Holman tellers.

(The Secretary then cast the ballot and the tellers reported accordingly.)

THE VICE-PRESIDENT :—The next officer to be elected is the Vice-President.

MR. SHELDON :—I would nominate Mr. H. C. McCarty.

MR. MCCARTY :—Mr. President, I respectfully decline the nom-ination, and would nominate Mr. Barhydt.

MR. MOONEY :—I second the nomination.

MR. POMEROY :—I move that the nominations be closed.

MR. SHELDON :—I second it. Carried.

MR. MOONEY :—I move the Secretary be authorized to cast the ballot for the nominee for Vice-President, Mr. Barhydt.

(The Secreeary then cast the ballot and the tellers reported accordingly.)

THE VICE-PRESIDENT :—Nominations will now be in order for four members of the Executive Committee.

MR. MOONEY :—I nominate Mr. Rosevear, Mr. Pomeroy, Mr. Macbeth and Mr. Charles E. Turner for members of the Executive Committee.

MR. KOPPERMAN :—I second it.

MR. MOONEY :—I move the nominations be closed. Carried.

MR. MOONEY :—I move the Secretary be authorized to cast one ballot for the persons named.

Seconded and carried.

(The Secretary then cast the ballot and the tellers reported accordingly.)

(The Secretary then made an announcement of the entertainment and dinner to follow the meeting.)

THE VICE-PRESIDENT :—Has any member anything to bring before the Club at this time ? If not, a motion to adjourn will be in order.

On motion the meeting duly adjourned.

THE NEXT MEETING.

The next regular meeting of the Club will be held at the Hotel Iroquois, Buffalo, N. Y., on Friday, March 13, 1903, at 2 P. M. The Executive Committee will meet at the same place at 1 P. M.

UNFINISHED BUSINESS.

Discussion will be continued on the paper read before the Club in January by Dr. Charles E. Lucke, of Columbia University, New York, on "The Indicator as an Engineer's Instrument."

RULES OF INTERCHANGE.

Recommendations as to changes in the Rules of Interchange, to the Arbitration Committee of the M. C. B. Association, will be reported by a special committee, of which Mr. G. N. Dow, M. C. B. of the L. S. & M. S. R. R. is Chairman.

WRITTEN OPINIONS.

Members unable to attend the meeting, or reluctant to give their views orally, are urgently invited to discuss scheduled or other topics in writing, sending their contributions to the Secretary early enough to permit of the same being presented at the Club meeting. Signing such articles is optional with the contributor.

Harry D. Vought

Secretary.

March 7, 1902,

J. O'CONNOR,

General Storekeeper, D. L. & W. R. R.

October 14, 1902,

G. M. DAVIS,

C. C. I., Pennsylvania R. R.

Important Notice to Members.

As the list of members will be published in the March Proceedings, and in order to avoid errors, if your official title, headquarters and address have been changed during the past twelve months, the Secretary should be immediately notified of the same.

The new rule governing the interchange of Proceedings with sister Clubs is now in effect. Members wishing the reports of the New York, Western, New England, St. Louis, North West Southern & Southwestern, Pittsburg and Canadian clubs should give notice to the undersigned accompanied by 50 cents for each club whose proceedings are ordered.

HARRY D. VOUGHT,
Secretary.

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OFFICIAL PROCEEDINGS

Central Railway Club

Vol. 9 March Meeting, 1903 No. 2

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HARRY D. VOUGHT, Secretary, 62 Liberty Street, New York

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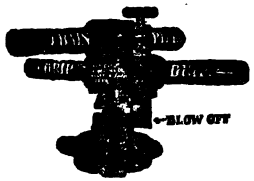

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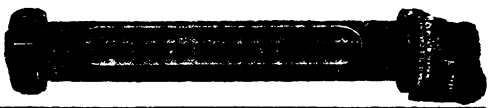

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OFFICIAL PROCEEDINGS

..OF THE.

CENTRAL RAILWAY CLUB

VOL. 9. NO. 2. NEW YORK, March 13, 1903 $1.00 PER YEAR 25 CENTS A COPY.

REGULAR MEETINGS AT BUFFALO: SECOND FRIDAY IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER, AT 2 P. M.

PUBLISHED IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER at No. 62 LIBERTY STREET, NEW YORK.

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L. R. POMEROY, Spl. Rep., R. R. Dept. Gen. Electric Co., New York.

NEXT MEETING, Friday, May 8, 1903, at 2 P. M.

THE MARCH MEETING

HOTEL IROQUOIS,
BUFFALO, N. Y., March 13, 1903.

The regular meeting of the Central Railway Club was held at the Hotel Iroquois, Friday, March 13, 1903, at 2 P. M., President West in the chair. The members registered in attendance included the following:

MEMBERS PRESENT.

F. D. Adams,	Amos Gould,	E. A. Phillips,
S. D. Anderson,	W. J. Hurley	H. H. Perkins,
W. T. Burton,	C. H. Hogan,	T. Rhodes,
A. B. Brown,	G. F. Knaus,	H. W. Sheldon,
H. S. Bradfield,	E. Kopperman,	William Tunkey,
L. T. Canfield,	W. E. V. Kemp,	W. C. Turner,
G. N. Dow,	P. J. Langan,	H. N. Turner,
O. M. Foster,	James Macbeth,	C. E. Turner,
Arthur Gemunder,	Robert McKenna,	George M. Treffts,
C. R. Green,	W. R. Maurer,	F. W. Williams,
F. C. Ganson,	T. J. O'Donnell,	George W. West.
	Robert Potts,	

Among the visitors in attendance were W. J. Robertson, of St. Albans, Vt.; D. C. Ross, general foreman car department of the Michigan Central R. R.; George E. Parks, mechanical engineer of the Michigan Central; J. N. Leslie, of Paterson, N. J.; William H. Huck, of the Ontario & Western R. R., Norwich, N. Y.

THE PRESIDENT:—Gentlemen, please come to order. I am pleased to see so many of the old members and such a large addition to our membership to-day. It goes to show what can be done by each member making an effort to bring one or more members with him, or non-members, and interesting them in our meetings. I think to-day's report of the Secretary, showing the substantial addition to our membership and the increase in our advertising, will assure us all that so far as our financial standing is concerned we are in good shape for another year. It has been suggested that our next meeting be held at Niagara Falls, and the matter will probably be brought before the members to-day for action; and I want to impress upon you all the necessity and the advisability of using your best efforts to increase the membership of this Club. If we can go on for the remaining months of the year with such an increase of membership as we have shown to-day, I am sure that the Central Railway Club will not be second or third in the standing of the clubs. Thanking you for your attendance, we will now proceed to the regular order of business, which is, first, the roll-call. The attendance cards will dispense with that.

MR. ADAMS:—What hotel at the Falls?

THE PRESIDENT:—We don't know that, Mr. Adams. The mem-

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bers will determine whether it is a good thing to do, but I merely wanted you to think about it. The next order of business is reading of the minutes of the previous meeting.

THE SECRETARY:—They have been printed and distributed, Mr. President.

THE PRESIDENT:—Nothing further under that head. Announcement of new members.

NEW MEMBERS.

The Secretary announced nine applications for membership, as follows:

T. S. Lloyd, S. M. P. & E., D. L. & W. R. R., Scranton, Pa.
LeGrand Parish, M. C. B., L. S. & M. S. R. R., Chicago, Ill.
H. N. Demarest, G. C. I., Pennsylvania R. R., Williamsport, Pa.
H. W. Sheldon, Standard Steel Works, New York.
J. W. Trounce, General Sales Agent Goodyear Lumber Co., Buffalo.
William J. Hurley, R. F., Western Division N. Y. C. & H. R. R.R., Buffalo.
Thomas J. O'Donnell, Arbitrator Buffalo & Suspension Bridge District, Buffalo.
W. R. Maurer, Chief Draughtsman B. R. & P. R. R., Rochester, N. Y.
Shelton Weed, Weed & Co., Buffalo.

THE SECRETARY:—Mr. President, the members will be interested in the fact that quite an addition has also been made to the advertising of the Club since the last meeting, through the efforts of the President, Mr. Tate and one or two other members of the Club—

THE PRESIDENT:—And the Secretary. You are too modest.

THE SECRETARY:—Well, I don't want to be too much in evidence.

THE PRESIDENT:—The next order is the report of standing committees.

PRATT & LETCHWORTH COMPANY, Malleable and Steel Castins

REPORT OF THE EXECUTIVE COMMITTEE.

THE SECRETARY:—The Executive Committee has received the resignations of H. A. Fergusson, James N. Moore, of B. M. Jones & Co., and George A. McNichol, of the Grand Trunk, the latter withdrawing on account of the organization of the Canadian Railway Club.

Under the rules we have to consider the suspension of twenty members who have failed to pay their dues for the past year. These gentlemen were notified, first, formally by a circular, as required by the Constitution, and then, after our annual meeting, a polite letter was written, expressing the hope that they would not withdraw from the Club; but if such was their intention, the Club would appreciate the payment of their arrearages. The list was very much longer, gentlemen, at that time, but it has been reduced to-day to twenty. The Secretary believes he is justified in saying that as a result of the canvass of this list by members of the Executive Committee a further reduction will be made in this list before the next meeting through the efforts of our President and members of the Executive Committee.

At our last meeting there was not sufficient time to consider a communication from the Car Foremen's Association of Toledo, asking for advice with reference to Rule 28 of the Revised Rules of Interchange:

(Reads communication from Mr. M. Kirby, the Secretary, published in the January Proceedings.)

It has been suggested that this subject be laid over until the report of the Committee on Rules is taken up, as a matter of unfinished business.

The Executive Committee have great pleasure in saying that Prof. W. F. M. Goss, of Purdue University, who was asked to favor us with a paper in May, finds that owing to the college examinations then being in progress, it will not permit of his doing so, but he will at any date we may name for the fall season. The month of September has been selected, and Prof. Goss will be so advised.

The Brooks Memorial Hospital wishes to divert part of the money which this organization donated the institution and was intended for an elevator. The Hospital has been presented with an elevator and they are installing a system of fire-escapes. It is quite possible they may need this money for that purpose, and they have asked permission to divert it to the general fund. The Executive Committee recommends that the necessary permission be given.

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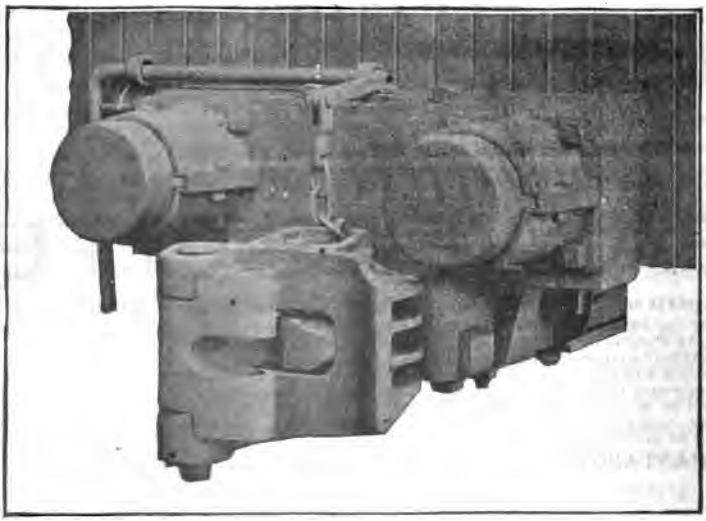

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The secretary of the Master Car Builders' Association asked for the appointment of a committee to make such recommendations as to the rules as might be desired by this Club. He was advised the committee had been appointed and will report at this meeting.

After the adjournment of our last annual meeting a communication was received from the Railway Club of Pittsburg, asking this Club, in common with all mechanical railway clubs of this country, to concur in the appointment of a general-subject committee, to be composed of one member appointed by each club, this committee to meet and arrange a list of subjects for the year, all clubs to have a paper and discussions on the same subject in the same month. The Executive Committee have considered this matter and have voted that it is impracticable for a number of reasons, among them the fact that this Club meets but once in two months. They are disposed to concur in the action of the Western Railway Club. I understand the same action was taken by the New York Club. The Western Club advises as follows:

Mr. H. D. Vought, Secretary Central Railway Club, New York City.

WESTERN RAILWAY CLUB,
Office of Secretary,
CHICAGO, Feb. 18, 1903.

DEAR SIR:—At a board meeting held here yesterday the communication from the Pittsburg Club was considered, and I was instructed to advise the secretary that the Western Railway Club did not approve of the suggestion owing to the impracticability of the objects to be attained. It was thought, by such a procedure, that the individuality of the clubs would be lost to a certain extent, and unless great care was taken in the selection of subjects for general discussion, the advantages would lie with one or more clubs as against the others. For instance, in the matter of maintenance of steel cars, the Pittsburg Club and the Central Club would be about the only ones that would be able to give anything very definite, and the subject would not be of interest to such clubs as the Rocky Mountain Club, or the Pacific Coast Club, or even the New England Club; and in the matter of extraordinary care of air-brake equipment, this would be more interesting to the clubs in the mountainous sections of the country than to the Eastern clubs.

Mr. Van Alstine, president of the Northwest Club, was here yesterday, and he advised that his club had taken about the same action.

Yours truly,

JAMES W. TAYLOR, *Secretary.*

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The Executive Committee recommends concurrent action.

The Executive Committee recommends for election to honorary membership, owing to their retirement from active railway service: Eugene Chamberlin, John Mackenzie, John Mostberger and Isaac Bond.

The Executive Committee recommends the reorganization of the question-box department, and in the event of the Club agreeing with this action, the appointment of a committee to take charge of and reorganize it, to be composed of Mr. Maurer (chairman), Mr. Rosevear and Mr. Hogan.

Mr. Waitt, of the New York Central, on the occasion of Dr. Luckie's visit to the Club in January, provided him with transportation. The Executive Committee have directed that his kindness and courtesy be properly acknowledged. Dr. Luckie yesterday sent me a note, at a late hour, saying that he was very ill with grip and would not be able to be here, but he would be very glad to answer any inquiries that might be sent to him through the Secretary in reference to the paper read in January on "The Indicator as an Engineer's Instrument."

EXECUTIVE COMMITTEE'S RECOMMENDATIONS.

THE PRESIDENT:—In reference to the number of members who are delinquent in their dues, I think that with a great many of them it is due entirely to carelessness on their part and not to indifference to the Central Railway Club. I know that this is true in the matter of delinquent members of the New York Railway Club; that when individual members who were personally acquainted with them went to them and explained the matter, they very freely paid their back dues. While it would be very embarrassing to some of these members who are delinquent to have their names appear in print, they would probably much rather be dropped. I think we all of us could do a great deal of good in getting some of these members back into the Club. Anyone who feels interested can get the names from the Secretary and probably will be able to induce one or more of them to retain their membership.

In regard to the making four of our members honorary members, I think that that matter ought to be well considered before it is decided. It is a question in my mind whether some of these members have actually resigned or retired from active railway service, and

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THE ENTERTAINMENT COMMITTEE.

BUFFALO, Sept. 28, 1903.

Mr. Harry D. Vought, Sec'y Central Railway Club, New York.

DEAR SIR:—Referring to the inquiry made in your circular postal card of the 23rd inst., I have no suggestion to make that I think would be of any value to the entertainment committee. That committee is certainly a very competent one and they are really in better position than any one to determine what would be most agreeable to the membership of the club at large. It seems to me they have been quite successful in the past in whatever they have done.

Sincerely,

O. P. LETCHWORTH.

PNEUMATIC TOOLS ON RAILROADS.

With reference to a special paper to-day on "Pneumatic Tools and Their Application to Railroads," it was not possible to close the engagement for this meeting. A number of gentlemen connected with the Chicago Pneumatic Tool Co., who wished to be present when the paper was read, are at Chattanooga at this time attending another convention and the matter is held until our January meeting at which time we will also have a paper from Prof. Magruder of the Ohio University. His subject will be "Gas and Gasolene Engines in Railway Work."

This is about all all at this time that would naturally come from the executive committee. The next in order is a paper by Prof. Goss of Purdue University.

THE PRESIDENT:—I think it is nearly two years since Prof. Goss honored us before and I have great pleasure in presenting to you to-day Prof. Goss. (Applause).

PROF. GOSS:—Mr. President and gentlemen, I assure you that it gives me great pleasure to be with you to-day. I have good reasons for concluding that this is the most wide awake railway club in the country. I have been down in New York where their railway club meets at eight o'clock in the evening, and out in St. Louis, where they meet at the fashionable hour of six, and in Chicago two o'clock is the hour, but here I find a railway club which begins its work the first thing in the morning.

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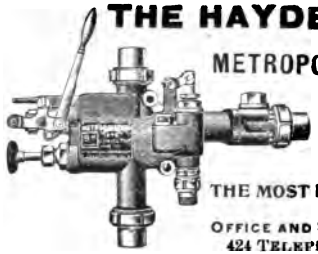

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unless they have, I do not see how we could make them honorary members. I know two of the members are practically young men, and it does not seem possible that they have actually retired from railway service. Many of the members are better acquainted with these men than I am, and I think we ought to consider it well before making them honorary members.

If there is nothing else under that head we will proceed to New Business.

THE SECRETARY:—Nothing on the Secretary's desk, Mr. President.

THE PRESIDENT:—Under that head wouldn't these two matters come up?

THE SECRETARY:—Unfinished Business.

THE PRESIDENT:—Gentlemen, what is your pleasure in regard to the four names mentioned?

MR. MACBETH:—Read them over again, please.

(The Secretary then read the names.)

THE PRESIDENT:—The Executive Committee to-day was composed of but two active members, and it was hardly fair for them to pass upon this question. It would be better, I think, if all the members were present when this thing is finally considered.

On motion, duly seconded and carried, it was determined to refer the matter back to the Executive Committee for their further consideration and recommendation.

THE SECRETARY:—The next is the consideration of the suggestion of the Railway Club of Pittsburg.

THE PRESIDENT:—That subject was thoroughly discussed by the Executive Committee of the New York Club, of which I am a member. I think the value of the clubs would be very materially interfered with if we agreed to the proposition. Localities have a great deal to do with the subjects that are interesting at each club meeting and I should very much dislike to see the Central Railway Club favor the recommendation of the Pittsburg Club in this respect. I will be glad

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to have your pleasure in the matter, or to hear the matter discussed. Mr. Canfield, what do you think about the propriety of having a standard subject?

MR. CANFIELD:—Mr. President, I heartily agree with just what you state. I do not feel as if I were much of a railroad man any more. However, I do not think you could well have standard subjects, as subjects must be taken up suited to the particular locality, and my suggestion would be that this Club take the same action that the Western Club has.

THE PRESIDENT:—You make that as a motion?

MR. CANFIELD:—I do; yes, sir.

MR. MACBETH:—I second it. (Carried.)

DR. LUCKIE'S PAPER.

THE PRESIDENT:—The Secretary calls my attention to the fact that under the head of Unfinished Business Dr. Luckie's paper should be again brought to the attention of the Club. Unfortunately Dr. Luckie is unable to be present with us to-day, but no doubt we can provoke a discussion on this matter if the members will start the ball rolling. The paper is now open for discussion.

MR. CANFIELD:—Mr. President, if I may be permitted to make a suggestion; don't you think it would be a good idea to postpone this discussion until the Doctor can be with us? It would be hardly fair to him to discuss and criticise his paper—if there be any criticism to offer—without his being here to defend it.

THE PRESIDENT:—I think the suggestion is a good one, Mr. Canfield, and unless there be some objection to it I will so order or rule.

The Secretary says there is nothing under the head of New Business.

The next in order is the Report of Special Committees and Reading of Papers.

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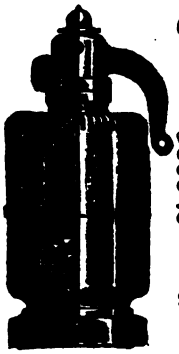

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REPORT OF THE COMMITTEE ON RULES.

THE SECRETARY:—The report of the Committee on the Rules of Interchange, Mr. President, comes up under this head, and is as follows:

PRESIDENT AND MEMBERS OF THE CENTRAL RAILWAY CLUB:—

Your Committee appointed to consider the subject of changes in the Rules of Interchange beg to report as follows:

First.—It is suggested that it is advisable to incorporate a clause in the Rules of Interchange allowing the use of the following material of proper strength and fit, regardless of variation of pattern from original construction, for cars of 40,000 pounds capacity or under, viz.: Journal boxes, brasses, wedges, break-heads and shoes, center plates, pocket couplers when replacing spindle couplers, but not spindle couplers in replacing pocket couplers.

Second.—The advisibility of changing the reading of price from $2.00 to $1.75 for hose in Rule 91 to read, "Complete, ready for application," thereby avoiding the present confusion in regard to 3c. extra allowed for removal and application by Rule 109.

Third.—The advisability of receiving roads transferring cars and standing cost of same, or if more advisable for the receiving and delivering road to each stand one-half of cost, the receiving road to do the work.

Fourth.—The advisability of incorporating in the M. C. B. Rules the answer to Question "H" of Decisions of Per Diem Arbitration Committee, Sept. 1, 1902.

Fifth.—The advisability of more clearly defining Rule 32, as to whether the term "Air Brake Fittings" is intended to cover the pipe and pipe couplings or just such parts as are purchased from the Air Brake Company.

Sixth.—The advisability of leaving out the words "coupler pocket and coupler pocket rivets" in that part of Rule 104, Page 37, which relates to "couplers with stem attachments, coupler springs, etc."

Respectfully submitted,
G. N. DOW,
H. M. CARSON,
Committee.

THE PRESIDENT:—I would ask Mr. Dow if he cares to say anything more on this subject?

MR. DOW:—No. I think the report gives all I have to say. I understand there is a minority report.

PRATT & LETCHWORTH COMPANY, Malleable and Steel Castings

THE PRESIDENT:—Well, gentlemen, the paper is now before you, and Mr. Dow says he understands Mr. Macbeth has a minority report or has a few remarks to offer in regard to the matter, and we would be glad to hear from Mr. Macbeth.

MR. MACBETH:—Mr. President, I would say in regard to the statement made by Mr. Dow, it appears somewhat misleading. If I remember the matter correctly, I received a communication from Mr. Dow on Saturday, stating that a meeting would be called on the following Monday, and I immediately wired Mr. Dow that it would be impossible for me to attend the meeting on that date, having a previous engagement. I heard nothing from the gentleman on the subject. I understand, however, that Mr. Dow and Mr. Carson presented a report. Under these circumstances I fail to see why a minority report is expected from me on this matter.

THE PRESIDENT:—Gentlemen, it seems to me this first recommendation of the Committee is a very important one. It is surprising how many cars of 40,000 pounds capacity are still being interchanged, and it is a still further great surprise to know that they are cars belonging to our great trunk-line systems. I am sure that I have seen in the past thirty days in our yards twenty-five cars that evidently had been used for "Italian" cars or for other than freight cars, that had been pressed into service. It seems to me that the recommendation of the committee is a very important matter and I would like it thoroughly discussed or some action taken. I think that the Arbitration Committee look to the Central more than to any other club for recommendations in regard to interchange rules. We will take up the first recommendation of the committee. Mr O'Donnell, what are your views in regard to that matter? You probably see as much of that as any man present.

MR. O'DONNELL:—Mr. President, it occurs to me, at a hasty glance, that the recommendations of the Committee, that the approval of such a step by this Club at the present time, would work more or less of an injustice to the trunk lines, owing to the fact that many of the lines have as yet a large quota of 40,000 capacity cars in service. Personally I might state in travelling around the district of Buffalo and Suspension Bridge, little or no trouble is experienced with wrong repairs on the class of cars mentioned; however, I do not care to place myself on record positively until I have fully looked into the subject from an acceptance point made by your honorable committee.

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THE PRESIDENT:—Mr. Turner, what do you think about that recommendation?

MR. C. E. TURNER:—Well, really, Mr. President, I am not prepared to speak on that subject myself. I think that Mr. O'Donnell is in a better position to answer that at the present time, in view of the fact that he is arbitrator here and comes in contact with that more than any other person.

THE PRESIDENT:—Mr. Canfield, what would you think of that from the standpoint of a master car builder?

MR. CANFIELD:—Before answering, Mr. President, I would like to know the Committee's reasons for making that suggestion?

MR. DOW:—We have to hold quite a large number of cars waiting for material from the owners.

MR. CANFIELD:—Well, speaking from the point of a master car builder, Mr. President, I would not be in favor of that rule yet, as I know some of the larger trunk lines have a great many forty-thousand-capacity cars. I know of one line that has at least ten thousand to-day out of a total of twenty-eight. Some of them may be marked fifty-thousand capacity but are really forties. I might just as well tell what road it is; it is the D. L. & W.; and with my three and one-half years' experience with that line, I do not think that we had any trouble to speak of with wrong repairs. I think that we had very few repairs to those cars that we could term wrong repairs. And while that company is working that class of car out it is bound to be with them for several years to come. It would be an unfortunate thing to have one of those cars running over your lines with three or four kinds of brasses in it or three or four kinds of boxes. As regards the coupler question, I think the M. C. B. Rules already take care of that. You are permitted to use an M. C. B. coupler by carding for any change in the uncoupling device, if I remember correctly. The brake-heads and shoes, I don't know that we ever had any great trouble in making repairs to foreign cars of 40,000 capacity, and what is more, I think there are a greater number of 40,000 capacity cars in the West than there are in the East. I can say that I have seen within the last three years new cars built of 40,000-pounds capacity. For those reasons I would not favor the rule.

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THE PRESIDENT:—Mr. Robertson, what do you think about the rule?

MR. ROBERTSON:—Mr. President, I have been out of the railroad business for the past three years, but have tried to keep in touch to some extent with what has been going on. I happened in here to-day quite unexpectedly, and am not very well posted on the matters under discussion. It seems to me that, as Mr. Canfield states, there are cars having different kinds of journal-boxes, brasses, etc., foreign to the original construction, and, as I understand the matter, a car could be repaired (when the truck frame would admit of it) with an oil-box and brass for 4¼x8 journal that was orginally built for a 3¾x7 journal.

THE PRESIDENT:—I don't understand it so.

MR. CANFIELD:—You couldn't get it in.

MR. ROBERTSON:—They could by changing oil-boxes, put in a smaller or larger journal as a makeshift, according to the capacity of car, as I note in my travels, many 40,000 and 50,000 pound capacity cars mixed up in trains having 80,000 and 100,000 pound capacity cars, and it would seem to me as though the matter could be held open a while longer.

THE PRESIDENT:—If you will notice, gentlemen, the recommendation reads, "of proper strength and fit." It is only a question of variation in pattern. You could't very well get a 60,000 pound box in a 40,000-pound truck unless it were a case where, as a great many roads do, destroy the 60,000-pounds capacity car. They are saving those trucks. That is the policy of our company. We don't perpetuate a 40,000-pound truck, but if we have a 60,000-pounds capacity car wrecked and we have a car coming into the shop that is in very good condition—40,000-pound car—we put the 60,000-pound capacity truck under it. It seems to me there is nothing mentioned there that would interfere very much with the patterns or the standards of a railroad.

MR. ROBERTSON:—Well, as I understand from Mr. Dow, the trouble is that the cars are being held waiting for material to be sent by the owners?

THE PRESIDENT:—Yes, sir. On the per-diem system that you are working under now a car might be held out of service thirty days;

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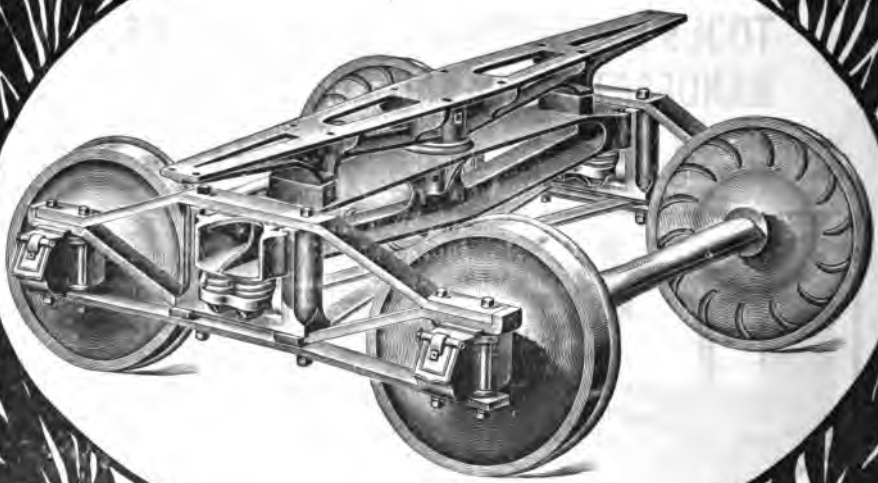

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under the difficulties we are experiencing in getting parts by way-freight—like an oil-box. The company that owns the car wouldn't feel like standing the expense of sending it by express, and certainly the road on which the car is being held wouldn't authorize it being sent by express, and frequently that car might be held out of service for thirty days without earning either company any revenue, for a matter of form of the journal box.

MR. ROBERTSON:—Well, under those circumstances it would seem to me if they could put something in that would get the car along according to the schedule that is made up, it would be an advantage.

THE PRESIDENT:—Mr. Adams, would you care to express an opinion in regard to the matter.

MR. ADAMS:—I don't know as it is very proper for me to express an opinion, Mr. President.

THE PRESIDENT:—Why not?

MR. ADAMS:—I am out of the business so long.

THE PRESIDENT:—You have an opinion?

MR. ADAMS:—Well, my opinion was—

THE PRESIDENT:—You may persuade these members to vote one way or the other, as they would not if they had not heard your opinion.

MR. ADAMS:—I have seen a great deal of trouble of that kind, waiting for materials. and, as you just remarked, they lose the use of the car. Cars are in great demand at the present time. And it is not a very difficult matter to find something that would fit a car—

THE PRESIDENT:—That is right.

MR. ADAMS:—That would carry it just as well, only it would be of different style and character from what it originally was. As those cars are wearing out all the time, and quite rapidly, it does not seem to me it would be a very serious thing to adopt the resolution as recommended. I am inclined to think it would be a good thing. I think Mr. Dow is right about that. It delays a good while in getting material from far away, a great many times, or else you have got to

go to work and make a pattern, which would be equally as much delay. So that in any event you have got a long delay. A car may be loaded. It would be a very simple matter if you had a box that would answer the purpose—of course it is understood that the thing shall fit. The very idea is clear enough in that respect, that it shall fit. Wouldn't expect to put a 60,000-pound box or an 80,000-pound box in a car of 40,000 pounds. So that if the thing fitted, I can not see any objection whatever.

MR. CANFIELD:—Mr. President, may I ask if the Rules do not allow you to substitute M. C. B. parts when of proper fit?

THE PRESIDENT:—Yes, sir.

MR. CANFIELD:—Will not the 40,000-capacity M. C. B. box fit, we might say, any 40,000-capacity car; and will it not take an M. C. B. brass and wedge?

THE PRESIDENT:—I don't think there is any such thing as a 40,000 M. C. B. box.

MR. CANFIELD:—I think there is. I am sure there is; 3¾x7, if I am not mistaken, is the 40,000.

THE PRESIDENT:—That wouldn't be 40,000, would it?

MR. ADAMS:—I think Mr. Canfield is right about that. I think it requires the 3¾x7 journal brass. If you have your M. C. B. proceedings here I am sure you will find it goes.

MR. TURNER:—4¼x8 is 60; 3¾x7 for forty.

THE PRESIDENT:—I look at it in this light; that the expense of a journal box, if a road cared to maintain strictly a standard box; we will take a journal box for illustration; we will say that the D. L. & W.—that we found a D. L. & W. on the Ontario & Western with a broken journal box and we had a 40,000-pound box that would fit that car, and we put it in; and on the other hand, if we were to send to the D. L. & W. and were required to wait, we will say, thirty days, we surely couldn't get it inside of twenty days—what that car would earn in twenty days would enable the D. L. & W. to put a set of boxes under the entire car; would pay for their changing the box we put under, or vice versa. And

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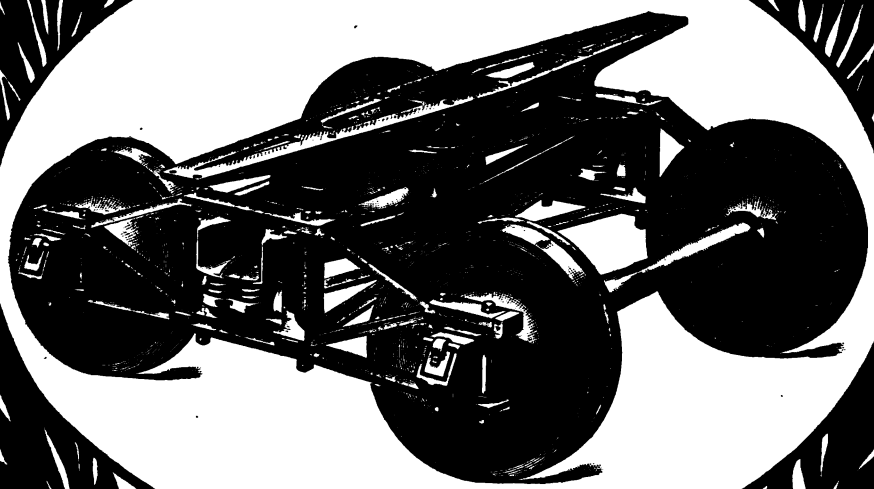

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it seems to me with our effort here now, the rules are all working in one direction, to keep cars moving. I have no doubt in my own mind that at the next meeting of the association that the receiving roads will be made responsible for all transfers. It stood a good chance of passing last year and I think it has gained enough advocates during the past year to warrant me in thinking that the receiving road will be responsible for any transfers in the future. Those are all on the lines of keeping the cars moving. We had a case yesterday at Middletown in which our foreman called my attention to a Lake Shore car—I think it was—with a side-door gone. We could have made a door in half an hour or an hour to fit the car, but we hadn't the fixtures. Now that car would either be held up until we could send to the Lake Shore road for fixtures or let the car go on, if it would be received with a card. It is policy under the per diem rules to hold that car and send for the fixtures, but I think that is working in the wrong direction. I think we ought to work in the lines of keeping the cars moving. What is your pleasure, gentlemen, in regard to the first recommendation?

MR. CANFIELD:—Mr. President, I move that the recommendation of the Committee stand as printed. I make this motion in order to get it before the Arbitration Committee for their consideration.

MR. BURTON:—I second the motion. (Carried.)

MR. MACBETH:—Mr. President, before disposing of the subject finally, I would like to revert to a remark you made a moment ago, which was in substance that receiving roads would have to pay expense of transfer, you stating that it came near passing at last year's convention. My understanding was that it was disposed of very promptly as not being for the best interests of the roads interested. It occurs to me that it would work a great hardship to the Trunk Lines accepting eastbound freight at Buffalo.

MR. CANFIELD:—I believe there were more telegrams sent to Saratoga to managers of railroads on that rule than anything else.

THE PRESIDENT:—I want to say, in connection with that statement of Mr. Canfield, that that may be true, but I think general managers have changed their minds—I know our general manager has—since that time. Now we will consider the committee's second recommendation. I would say, gentlemen, that the arbitration committee has passed on that.

MR. MACBETH :—They have ? Well, that is a good thing.

THE SECRETARY :—That is to be stricken out?

THE PRESIDENT :—That is to be stricken out.

MR. O'DONNELL :—I move you, Mr. President, that the recommendation be passed as printed.

THE PRESIDENT :—The Arbitration Committee has passed upon that, that the three cents charge should be eliminated.

MR. O'DONNELL :—Yes, I was aware of that fact, but I supposed you would carry these right along. Do you wish to eliminate it?

THE PRESIDENT :—Oh, all right. Was that motion seconded?

MR. MACBETH :—I second it. Carried.

The Secretary read the Committees third recommendation.

THE PRESIDENT :—Now, gentlemen?

MR. MACBETH :—As previously stated, Mr. President, summed up briefly, the situation is as follows: The roads in our Association centering at Buffalo and Suspension Bridge, have thoroughly discussed the situation for the past two or three years. We all know full well it would be a marked advantage for the western connections under the proposed arrangement, to deliver at Buffalo any class of car or lading. This would directly interest all of the Trunk Lines leading out of Buffalo east. This matter was discussed recently at a meeting of the representatives of all the railroads and my individual opinion is, the matter should rest entirely with the traffic department, and not be taken up by the Master Car Builders Association. It is entirely a question for the agents to dispose of, providing the car proper is not defective. This, of course, refers exclusively to high and wide cars. Invariably the lading is obliged to go into two cars when transferred. I believe all the gentlemen present here to-day will bear me out in this statement.

THE PRESIDENT :—You remember, Mr. Macbeth, the New York, New Haven & Hartford people said they couldn't stand the per diem system of interchange but they are taking their medicine.

MR. ADAMS :—The New England roads are all suffering from the per diem business some hundred-and-seventy-five or two hundred thousand dollars a year.

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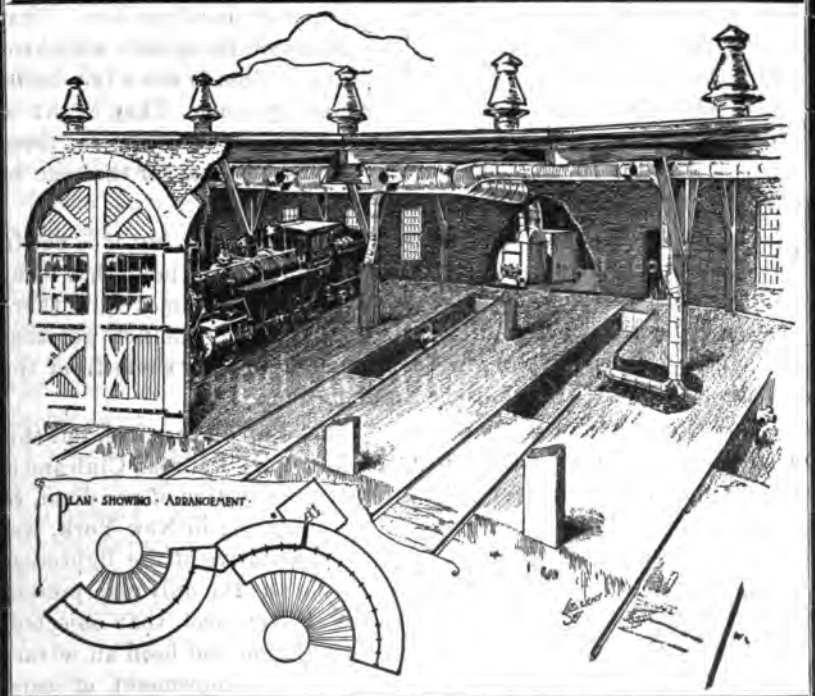

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THE PRESIDENT:—I think, Mr. Adams, that that is not fairly represented in dollars and cents. When you consider what the New England people were doing, they had no freight houses, they used the other people's cars for their freight houses. If they would take the money invested in freight houses which the roads of the Central territory and the West are doing, and the interest on that money, it would go a long ways towards paying for their per diem charges. That is what they have been doing. They take a car of coal over there, take one of the Ontario & Western cars of coal over there, and hold it a month, dealing out the coal in quantities of ton lots. That is only just one item. They would do the same thing with merchandise; they would hold the freight in cars. That is not a fair basis, to say what they are doing on the per diem system. They ought to credit that account with what money it would be necessary for them to expend in the shape of maintaining freight houses for the sake of taking care of their business.

MR. ADAMS:—That may be true in some respects, but it is not in all. There is a great deal of ocean freight, you know, that they couldn't get unloaded rapidly, a great deal of ocean freight there that will be transferred on board of ships; they cannot get that unloaded as fast as they ought to or enough to clear them from the per diem system. It costs them a pile of money.

THE PRESIDENT:—I do not want to take up all the time, but this matter of per diem was discussed at the New York Railroad Club and it was demonstrated very, very forcibly that the question of per diem, so far as it is concerned touching the roads centering in New York, was simply a question of lighterage, and a representative of the lighterage company was present at the meeting and he was the only man present except one man, I think, from the New Haven road, that objected, but who acknowledged that the per diem system had been an advantage to their roads both financially and in the movement of cars. It seems to me that is the question that confronts the railroads today. It isn't a question of motive power or of train service. It is a question of terminal facilities, and if this per diem system has put the thing up against the management at terminals, why, that is a thing for them to figure out, not us. We are too swift for them.

MR. ADAMS:—I think your argument, Mr. President, is good in the main. They haven't only half facilities enough, any of them. It affects all the New England roads pretty seriously.

THE PRESIDENT:—Mr. Dow, can't you give us some good reasons why this recommendation should be adopted? We have heard the unfavorable side. What is the favorable side?

MR. DOW:—In our experience, Mr. President, we found it better to receive the freight, transfer the car, or vice versa; let it go along; and we have adopted a rule to that effect at Cleveland, and out of 500 cars during the month of November only seventeen rejected at Buffalo.

THE PRESIDENT:—The point that has been raised in favor of this, by the strongest advocates of the rule is that a great many cars or a very large per cent. of cars that are transferred are the result of some dispute between inspectors; that the records of every road that has followed this system show that there wasn't one-half the number of cars transferred when the road that objected to the car had to transfer it at its own expense. Now I can understand a case like Mr. Macbeth speaks of, but those are very few, it seems to me. I am not prepared to speak, but it would seem to me the cases to which he refers are only a drop in the bucket of the number of cars that are transferred at an important place like Buffalo, and if it is true that double the cars could pass from one road to another without being transferred, why, it seems to me it is a good rule. Now, I know with one of our connections that we have transferred or re-consigned freight from that one road more than all of our other connections together, and recently they have changed. Since Mr. Smith was made the general superintendent of the New York Central he has taken the matter up with this road in question; and the results are simply astonishing. We are not transferring one car where we did ten. Now the cars are in just the same condition they were before.

MR. PERKINS:—Mr. President, I probably have had more experience in transferring freight than any other man present.

THE PRESIDENT:—No doubt of that.

MR. PERKINS:—It has always been my railroad business to transfer freight, and with all the experience I have had I have come to the conclusion that the best way is to deliver a car to the road and say "There is your car and there is your freight; you can take the car and the freight or you can take the freight out of the car." You can figure on this car causing a road expense; you can figure on the

other car causing an expense; you can figure on delays; you can figure on this minor matter and the other minor matter; but when you take the question by-and-large, as a whole, the best way is to turn the car containing the freight over to the receiving road and say: "There's your car and there's your freight; you can repair the car, you can take the freight in the car or you can take it out of the car." You would hardly ask a drayman, if he would loan you his team to haul freight for which you are paid, you wouldn't ask him to pay for taking the freight off of his wagon and reload it on yours. You would only be too glad to get the business and earnings. The eastern roads run up against the use of large cars because the western roads, with their long, level tracks do not have the tunnels of the eastern roads, and the eastern roads are refusing cars for a half-an-inch too large dimensions, and then the question of transferring comes up; it, of course, has to be put into two cars. But taking the business as a whole, my experience has taught me the best way is to deliver the car and freight, and the receiving road take it and dispose of it without reference to the delivering road.

MR. MACBETH:—Mr. President, there appears to be somewhat of a misunderstanding on this subject. With all due respect to Mr. Perkins, who has had a large experience in this line, I will state our present agreement at Buffalo covers this point quite fully. Cars are accepted by the receiving line and transfers are very few providing the cars are in condition to run. We have had very little trouble since our agreement was inaugurated in this respect. Of course we all understand full well large loads of machinery and other commodities that cannot pass over the receiving company's line on account of prescribed limits cause more or less confusion and trouble. This is the point I desire to be made very clear, wherein the receiving company should be relieved of the responsibility of handling the same.

THE PRESIDENT:—It seems to me a case like that can easily enough be embodied in a rule that wouldn't be a question of transferring a car for its condition. That wouldn't be anything for the mechanical department to consider at all. As Mr. Macbeth said a while ago, that is a traffic matter.

MR. MACBETH:—Traffic matter entirely.

THE PRESIDENT:—Just what I had reference to, and what I

think the framers of this proposed change had in mind, was the cars in ordinary traffic, the interchangeable cars, you might say. Wasn't that the idea?

MR. DOW:—That was the idea.

MR. O'DONNELL:—Mr. President, such a practice is not permissible under our agreement at Buffalo and Suspension Bridge. No expense is charged to the delivering line for the transfer of a car for mileage purposes. It must have defects making it unsafe to carry its lading or outside the prescribed limits for eastern connections when a transfer order is given. I will say, with all due respect to the recommendations of the committee and the able gentleman preceding me, Mr. Perkins, that some consideration and reasoning should be given to the fact that the large majority of transfers is covered on eastbound equipment. Under such conditions it would not be fair or equitable to compel the lines taking the freight at Buffalo or Suspension Bridge to bear the expense of transfer on cars passing east, as I might add without hesitation that where one car is transferred at the points mentioned, westbound, ten are transferred eastbound. This is largely brought about owing to the fact that grain and other commodities traveling east require closer attention and better equipment than coal and coarse freight traveling west; also the question of empties traveling west should be taken into consideration. I merely cite these cases from my daily experience on the transfers approved by me in my present position, which, I believe, clearly illustrates the fact that the receiving line bearing the expense of transfers at Buffalo and Suspension Bridge, at least would not be an equitable arrangement.

THE PRESIDENT:—I am surprised at that statement.

MR. O'DONNELL:—Westbound lading is rarely transferred as a rule owing to the fact that it is largely made up of coal trade and coarse freight. The gentlemen here present to-day representing the western lines centering at Buffalo and Suspension Bridge, I believe, will bear me out in this respect.

THE PRESIDENT:—Is that eighty per cent. of the transfer or eighty per cent. of the loaded cars?

MR. O'DONNELL:—The total number, Mr. President, that are transferred for defects, high and wide, and other commodities. For

instance, a large number of those cars won't pass over the New Haven line, some won't go over the B. & A. division of the New York Central; and so on throughout the east.

THE PRESIDENT:—Mr. Potts, what are your views on this matter?

MR. POTTS:—My views lead me to believe that the receiving company doing the transfer and inspecting has helped us out without repairs at Suspension Bridge and Victoria to the extent of about twenty-five per cent. in repairs, besides keeping business going all the while.

MR. CANFIELD:—Mr. President, I think the agreement at Buffalo needs some explanation to make it clear to some of the members, perhaps. Mr. Potts just remarked that the arrangements entered into here saved him twenty-five per cent. I happened to be a party to that arrangement which is that the receiving roads shall take the car if it is in condition to move, but are permitted to transfer it and bill the delivering road for that transfer. That throws the expense on the delivering road. I think that is the proper way to handle it. I do not think you should send a load back; I think it should be transferred when it gets dangerous; but I think the party that caused the damage or received the car in such a condition that it would not go to its destination ought to stand that expense. I worked for a year in Kansas City, where they had the rule in effect that you are trying to put in here. The Kansas City people liked it. It was the proper thing. If we got a car from Chicago in bad shape and we could get it to our transfer in Kansas City we could get rid of it. It was an incentive to get it to the other fellow and make him pay the transfer. And I think it puts a premium on running cars in bad condition. For instance, if the Lake Shore people should get a car at Chicago that was defective, the inspector would say, "Well, that will go to Buffalo," and he would make no effort to make any repairs at all, and it would come to Buffalo. It is worse by the time it gets here and the Buffalo man says, "I'm afraid to let that go any further; we will have to transfer it, even though we do pay for it." I think you are placing a premium on running cars in a defective condition. Mr. O'Donnell just made a statement that eighty per cent. of the transfers at this station are on cars eastbound. When you stop to look into that, that is easily understood. The eastbound cars have come a long way, stood a good many severe shocks in switching, etc., and

the westbound cars have come a short distance, and were put in proper condition while empty, and will unquestionably pass Buffalo; but they are going to get it out about Chicago or Kansas City.

THE PRESIDENT:—Then wouldn't it even up?

MR. CANFIELD:—Well, no; as Mr. O'Donnell tells you that eighty per cent. of the lading is eastbound. Am I correct?

MR. O'DONNELL:—Eastbound. That is according to my knowledge, Mr. President.

MR. CANFIELD:—And a large percentage of the Western lading is package freight that is not hard on car equipment.

MR. MACBETH:—Yes—and are empties.

MR. CANFIELD:—I think it would be class legislation. It would be favoring one district and giving another district the worst of it. Whereas if you force the receiving road, let the receiving road make the transfer, force him to take the load, but let him make the transfer and then bill the road that did the damage. It looks to me to be the only fair way out of it.

THE PRESIDENT:—I am surprised that eighty per cent. of the lading is east. I remember reading the Inter-State Commerce Commission's report recently, and I thought it was nearer fifty per cent.

MR. MACBETH:—No, no. We have taken that for seven or eight years, Mr. President.

THE PRESIDENT:—Well, I am not in a position to say—just speaking from memory.

MR. O'DONNELL:—It must be clearly understood, Mr. President, that a large quota of these eastbound transfers is due to the height and width of the cars and not due to any defects to the car proper. It is safe to say that the seven roads carrying freight into Buffalo daily from the West, at least fifteen cars are cut out each day as being beyond the prescribed limits for eastern connections. You can very quickly figure out how this would bring the eastbounds to a greater extent than westbounds.

THE PRESIDENT:—I don't question the number of transfers. I question the number of loaded cars.

MR. O'DONNELL:—Well, it is largely made up of grain. Mr. Perkins is fully posted on that subject. And the westbound is coarse freight.

THE PRESIDENT:—Well, I don't know anything about it.

MR. MACBETH:—Mr. President, speaking on that point, I desire to state that in a given period of time in the neighborhood of fifty cars passed our inspectors that were held up by the eastern connections for transfer. It is unnecessary to state that we heard from our general officials on this subject.

THE PRESIDENT:—I remember that very distinctly.

MR. MACBETH:—They get down to some place where there is nobody to transfer them.

THE PRESIDENT:—Mr. Phillips, you are watching this car matter very closely. I would be glad to have your views.

MR. PHILLIPS:—Like some of the other gentlemen who have spoken here, I am a back number because I am no longer directly interested in car matters.

MR. CANFIELD:—I object. I am not so much interested, but I am not a back number. (Laughter.)

THE PRESIDENT:—That is right. We don't consider Mr. Adams a back number.

MR. CANFIELD:—Certainly not.

MR. PHILLIPS:—When the proposition came up to make some of the gentlemen who have retired from railroad service honorable members, it occurred to me that it is a difficult matter to determine when a man has retired from railroad service, for we all know of gentlemen who have retired and who have gone back into it again; and there are others who have retired and have gone very actively into the railroad supply trade, so that they are still, in a sense, active railroad men. I shouldn't be surprised any day to hear of Mr. Adams being president of a one-horse railroad, for instance, and so getting back into railroad service.

MR. ADAMS:—I would like to have the chance, with a good salary. (Laughter.)

MR. PHILLIPS :—But what I rose to speak to and what has made a considerable impression on me this afternoon, is the fact that here we have a committee presumably making recommendations which this club is asked to adopt and forward to the Arbitration Committee; the report of this committee is signed by two members, and the chairman of the committee promises us a minority report from one of the other members, who fails to make such a minority report, but gets up and very strongly opposes the recommendations. The moral to be drawn from that, I think, is the necessity for members of a committee working together a little more in harmony, and coming to the club with a recommendation they can recommend, and so avoid this collision of opinion in the club meeting.

MR. MACBETH :—That isn't the subject, I believe, before the house; is it, Mr. President?

THE PRESIDENT :—I just enjoy that kind of a report. I think it is pretty hard work to get three members of any committee to agree, and wherever a report comes in without any minority report it is generally the chairman who has been doing all the work. That has been my experience in association matters; that if there are three members of any committee, if it comes in unanimous, with all the members' signatures, you can make up your mind the chairman has done all the work, and I think we ought to have differences of opinion, and I think this is the place to voice them. That was the object of the association, in the Arbitration Committee, of having the Club take up these matters, because the men who are in the rank and file and familiar with these things can talk here what they wouldn't talk in an association meeting, and these things are brought before the association and half of the members are ignorant of what really the gist of the whole matter is, and vote with the crowd. I think this is the place to voice our differences of opinion.

MR. ADAMS :—If I understand this matter, Mr. President, the trouble is not so much with the cars that are not fit to run as it is with large cars that won't go over the eastern roads. Now, of course, Mr. Macbeth's railroad now goes clean into Boston and he has got the lower end of it there that won't take large cars. He has got to stop them somewhere, and I suppose he stops them here. They used to come down to Albany and we had them to transfer, when I was connected with the Albany road. The road down there has small tunnels,

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but if it is because the car is too big and it won't go through a tunnel, that is entirely another thing, and belongs to the transportation department. It seems to me we are talking about a thing that we really have nothing to do with.

MR. MACBETH:—Mr. President, that brings about a subject that I think ought to be clearly explained. In this connection I desire to state our inspectors do not condemn high and wide cars. We simply measure the height and width, place the measurements on side of car and furnish a copy of the same to the traffic department. It is then the duty of the traffic department to say whether the car will go forward or not.

MR. ROBERTSON:—A few weeks ago I was in the office of a general manager located in the East. I noticed he had a large quantity of diagram clearance circulars issued by the N. Y. N. H. & H. R. R., and he advised that every station agent on the line of his road was furnished with two to three copies each; every car inspector or man connected with the movement of and receiving of cars from foreign roads had one of these circulars, so as to prevent accepting or loading of a car for shipment destined to the N. Y. N. H. & H. system that would not safely go through their tunnels or pass under their low bridges. It seems to me as though all employees, from general manager down, are doing their best to prevent the billing or loading of cars that would be rejected on account of same not complying with the limits referred to.

MR. PERKINS:—That is just what I am complaining of. I have a stack six inches high of notices about different railroads in this country. A car was loaded via Newburgh to go over the New Haven road, and it was refused there. I had that car measured twice before loading. An explanation reported it an inch too wide—2 feet 11 inches from the top of the rail. Now, the diagram didn't cover that. I have heard more about that car than any other. I don't know what to load for the New Haven road to-day. I cannot load a car, except a little twenty ton car, for the New Haven road, because a door hasp or something may be sticking out too far. Those diagrams are not altogether reliable. When a man offers me a car of freight, I must go into my office and look over a lot of notices about the size of a car, and figure it out, and go and measure it, and tell him "No, you cannot load that car on account of its dimensions, but I will furnish

another." A car is obtained that apparently will pass, but on arrival at a junction is refused, and the delivering road after obtaining a car load for that route must not only pay the expense of transfer, but find a car for a road that objects to bringing its facilities up to date. Of course, this matter that we are discussing now does not apply to the mechanical department particularly, but it is well enough to bring these things up, and call attention to something aside from the regular question.

THE PRESIDENT:—Well, gentlemen, the action of quite a number of the roads recently in appointing mechanical men to the position of general superintendent ought to convince us that the owners of the properties are looking to the mechanical men of this country for information, and while this may not be strictly a mechanical question, I think that the proceedings of these railroad clubs are read by our general managers more than any of us have any idea of. As I said in the beginning, our general manager was opposed to this system a year ago, but I sent him proceedings of the Western Railway Club, where the matter was thoroughly discussed, and told him that I had voted against this change at the last meeting, and wanted his views, and he said, "I think it is all right," and it only proves what has been proven time and again, that the western fellows are at the lead. I don't think that we people at the east ought to have an impression go out that the western men are advocating all these changes. There was just as much opposition to what is known as the Chicago Interchange as there is to this. There was the greatest cry raised in the East when they talked about interchanging on what is known as the Chicago system, ten times more than there is against this, and yet we are all in favor of it to-day. Not a long while ago we had a car—at the lower end of our road we run jointly over the West Shore, and a car got through two of their tunnels that was six inches wider than their tunnel clearance, and six inches higher. When it arrived at the lower end they found the edge of the roof boards taken off on one side, and the car was unloaded, and we then asked the West Shore people whether we could bring that car up on a special train, or with a special engine, they said no, we couldn't do it; the car was set to one side, and we intended to send trucks down with 28 inch wheels; we had some 28 inch wheels in the shop; and while that car was standing there one of their trains got hold of the car, because the cars are loaded, one car by the Ontario & Western,

and one by the West Shore, and that car came up empty through that same tunnel, and nobody knew anything about it until it showed up at Middletown. That showed, as the gentleman just said, that the "tunnel clearance" don't amount to anything. And there is no doubt that many of the cars that have no restrictions put upon them could pass interchange without any trouble, but as has been said here before, if this thing is put up against the roads that are objecting to it, they will find some way out of it.

What is your pleasure, gentlemen, in regard to this third recommendation? Mr. Dow, what would you recommend? You say either full charge or half cost.

MR. DOW:—That is a question for the club to decide.

MR. CANFIELD:—I think it is something that ought to go before the Master Car Builders' Convention for discussion.

THE PRESIDENT:—Yes.

MR. CANFIELD:—As long as it is bound to come from the Western Railway Club in this form, I would like to ask the committee if they would not agree to change their recommendation to read that the car must be received, and the receiving company transfer the load and bill the delivering company for the cost of transfer? That would put the question before the Arbitration Committee in two different forms for their consideration. It is pretty sure to come from the Western Railway Club, if I understand your talk correctly, just as you have it here.

THE PRESIDENT:—Yes, sir. That is my understanding. What do you say, Mr. Dow?

MR. DOW:—I don't like to act on the committee alone on that.

THE PRESIDENT:—Mr. Carson isn't here, is he?

MR. DOW:—No.

THE PRESIDENT:—This is only to get the matter before the Club. This has no binding effect, you know. It is only a recommendation to the Arbitration Committee. Any action we take to-day doesn't bind anyone.

MR. DOW:—Well, it is agreeable, Mr. Macbeth says—

MR. MACBETH :—I will vote for it the way Mr. Canfield put it.

THE PRESIDENT :—Mr. Canfield, will you make the motion, then? Just as your practice is here, I understand. That is your practice?

MR. MACBETH :—Yes.

MR. CANFIELD :—My motion would be that their recommendations be changed to conform to the Buffalo practice; that the receiving road shall receive the car, and if necessary to make transfer, transfer the load and bill the delivering company for the cost of transfer. Is that right, Mr. Macbeth ?

MR. MACBETH :—That is right.

THE PRESIDENT :—Will you second that motion, Mr. Macbeth?

MR. MACBETH :—Yes.

THE PRESIDENT :—I suppose it would be first necessary to take some action on this.

MR. MACBETH :—Yes, bring it before the association.

THE PRESIDENT :—Gentlemen, what is your pleasure in regard to recommendation 3; that it be adopted or not?

MR. CANFIELD :—Didn't my motion put that straight, the motion I just made, the committee to change this in accordance with my motion?

THE PRESIDENT :—The committee agree on that, do they?

MR. MACBETH :—I agree with Mr. Dow on that; yes, sir.

The motion of Mr. Canfield was put to a vote and carried.

The secretary then read the fourth recommendation.

THE PRESIDENT :—What does that refer to, Mr. Dow?

MR. DOW :—That refers to this: Cars where owners are responsible for defects, the mechanical department has nothing to do with the per diem; the car accountant handles that; and the owners are responsible for the defects, and we bill the owners for it, at the same time our road has to pay the per diem, and we want to get the per diem returned. In other words, we want to put it in the bill.

THE PRESIDENT:—How do you feel about that, Mr. Macbeth?

MR. MACBETH:—I am not really in a position to talk about it, Mr. President; I haven't studied it enough.

THE PRESIDENT:—Mr. O'Donnell, have you any views that you care to express?

MR. O'DONNELL:—No, Mr. President, I am not fully posted on the subject, but if I understand Mr. Dow aright, and a car is held for owners defects—

MR. DOW:—Yes.

MR. O'DONNELL:—and the material is ordered from the owner of the car, the per diem charge should be included in the bill for repairs.

MR. DOW:—No, we make repairs; don't order it or anything of that kind; make repairs.

MR. O'DONNELL:—I might say there are not many such cases arising in the Buffalo and the Bridge District, and owner's defect is disposed of in at least half a day, and as I understand it the 20 cent limit includes a 24 hour hold over; that is the per diem rule.

THE PRESIDENT:—What would you do with a car door, Mr. O'Donnell, in case you had no fixtures for the door?

MR. O'DONNELL:—I was about to state, Mr. President, that my idea would be to board up the door opening, and get it forward providing the receiving line would accept the car. This is carried out in our agreement in Buffalo in many instances, especially on cars with Wagner doors.

MR. CANFIELD:—There is a special agreement among a great many railroads, whereby they will accept a foreign car at an interchange point with a side-door gone.

MR. MACBETH:—Mr. President, the matter is entirely reciprocal with the roads at Buffalo. They are disposed of ordinarily by boarding up.

THE PRESIDENT:—Not making a door of it at all.

MR. MACBETH:—No, take a hemlock board and nail it right up.

MR. CANFIELD:—If I am in order I might explain that at Elmira the Pennsylvania Co., have agreed with the D. L. & W. Co., that they will accept Pennsylvania cars back from the D. L. & W. with doors missing without making any charge, the D. L. & W. Co., entering into the same agreement with the Pennsylvania; and that arrangement is in effect at Syracuse between the D. L. & W. and the New York Central, and at Buffalo with most all roads, I think.

MR. MACBETH:—Yes.

MR. CANFIELD:—I feel safe in saying that that rule will be made national at the next convention. It was in the hands of the executive committee, and the executive committee recommends that it be made national at the coming convention.

THE PRESIDENT:—Then, Mr. Macbeth, would I understand if we had nailed up that Lake Shore car that it would have been received at Buffalo?

MR. MACBETH:—Yes, sir; under ordinary conditions, providing there is no evidence of unfair usage.

THE PRESIDENT:—Passed right along?

MR. MACBETH:—Yes, the cars are passed right along. All we make is the repairs, the line is not closely drawn. In order to keep business moving this is absolutely necessary.

THE PRESIDENT:—What is the pleasure of the meeting in regard to Rule 4?

MR. CANFIELD:—Have we got question "H," Mr. Dow?

MR. DOW:—Yes, I will let the Secretary read it.

(Secretary reads question H as follows:)

QUESTION (h).—The suggestion was made looking toward the charging of 20 cents per day up to the maximum time of five days from the arrival of the car at the shop or repair yard in addition to the cost of labor and material to cars repaired if the owners are responsible for defects.

ANSWER OF PER DIEM ARBITRATION COMMITTEE.—The committee can see no objection to this change in the M. C. B. rules, and the suggestion is made that it will be better to incorporate this in the M. C. B. rules rather than in the code of per diem rules.

Suggestion.—Your committee has considered the answers of questions (g) and (h) and would suggest that when cars with owners' defects are undergoing repairs on foreign roads on which per diem charges are accruing, an additional charge of 20 cents per day may be made against the owner, on the bill for repairs, in accordance with the number of hours prescribed in the M. C. B. rules for doing such work, regardless of the time used doing the work, provided that no charge shall be made for less than five hours.

The meaning of the words "per diem" as considered by your committee, includes the working day on the repair track, namely, ten hours. Where the time occupied is five hours or over it should be considered a full day ,and where less than five hours should not be considered; for illustration, if 32 hours are required to do a certain job of work, three days should be charged; if 36 hours are required, four days should be charged.

QUESTION (i) —It was suggested that a clearer understanding ing be given to the latter part of Rule 8, wherein it states that "per diem charges will cease from the date the necessary material is ordered from the owner until the date when it is received by the road holding the car." Does this mean when the material is received at a junction point or that the per diem will cease until the material is received at the point at which it is to be used, namely, a shop or inspection point?

ANSWER OF PER DIEM ARBITRATION COMMITTEE.—The date when it is recieved by the railroad would be the date when the car containing the material was recieved by that road, and not the date the material is received at the shops, the object being to put a premium on the prompt handling of material when it is received at the junction point, this interpretation of the rule has been accepted generally.

Your committee concurs in this interpretation of the rule.

For the Arbitration Committee.

JOS. W. TAYLOR, Secretary.

667 Rookery Bldg., Chicago, September 1, 1902.

MR. MCKENNA:—I move the recommendation be passed as printed. Carried.

The Secretary then read the fifth recommendation.

MR. TURNER:—I move that that recommendation be accepted as read.

MR. CANFIELD:—Mr. Phillips was just saying that that has been passed upon by the Master Car Builders Association some two or three years ago.

MR. MACBETH:—Yes, but they did'nt define it clear enough.

MR. DOW:—They did'nt define it clear enough.

(Seconded and carried.)

The Secretary then read the sixth recommendation.

THE PRESIDENT:—Will you please read Rule 104, Mr. Secretary?

(The Secretary then read the rule, beginning on page 36 of 1902 rules.)

THE PRESIDENT:—Mr. Dow, will you enlighten the club as to what the object is or why the change was recommended? What was the object in leaving those out, Mr. Dow?

MR. DOW:—On account of item 18, page 37, allowing three hours, and item 13, page 37, allowing two hours, which causes confusion in making charges.

MR. O'DONNELL:—Mr. President, I believe the object, taking some arbitration decisions as a basis, is the fact that a coupler, coupler pocket and rivets cannot be replaced for two hours, so the committee desire to separate the pocket and rivets as an additional charge to the coupler proper. This is my understanding of the recommendation as formulated by the committee.

THE PRESIDENT:—Mr. Canfield, will you—

MR. CANFIELD:—That is about it.

THE PRESIDENT:—That is the information, is it?

MR. CANFIELD:—I thought another thing why the recommendation was made, because it was impossible to remove the coupler pocket and rivets without removing the coupler; that they all three had to be removed, before you could remove the pocket and rivet.

MR. DOW:—I think that was Mr. Carson's idea.

THE PRESIDENT:—That those two should be eliminated from that charge.

MR. CANFIELD:—I think the recommendation is right.

THE PRESIDENT:—Anyone wish to speak on this subject?

MR. O'DONNELL:—I move you that the recommendation be adopted as stated.

MR. CANFIELD :—I second it. Carried.

THE SECRETARY :—That completes the report of the committee.

THE PRESIDENT :—Has anyone anything to offer for the benefit of the club; or any other suggestions or recommendations? Mr. O'Donnell have you any other recommendations to offer?

MR. O'DONNELL :—I haven't, Mr. President.

THE PRESIDENT :—Mr. Macbeth?

MR. MACBETH :—No.

THE PRESIDENT :—Mr. Potts?

MR. POTTS :—No.

THE PRESIDENT :—Is there any other business, Mr. Secretary?

UNFINISED BUSINESS.

THE SECRETARY :—Yes, the interpretation of Rule 28, asked for by the Car Foreman's Association of Toledo.

(Secretary reads.)

THE PRESIDENT :—What would you say, Mr. O'Donnell? Where is it necessary to renew the bolts for a wheel or axle that owners were responsible for, or delivering company responsible for?

MR. O'DONNELL :—For instance, one of the western lines would deliver a car with a cut journal. In removing the wheels it is natural to suppose on refrigerator cars more especially, the box bolts would be found rusty to such an extent that in removing them, they would have to be broken off, bearing in mind that the defect card orginally covered a cut journal, the Toledo people desire to know whether the bearings and bolts should be included in the charge, irrespective of whether they are on the defect card or not. I will state in our agreement at Buffalo, before approving of the charges, we insist that the journals be mentioned on the defect cards. This can be readily carried out in our work in Buffalo, as the receiving lines makes the repairs. However, I will say without hesitation, that the defect card for a cut journal or slid wheels gives any company the right to charge for journal bearings or box bolts, providing they are obliged to remove

the same whether they are on the defect card or not, as I believe this was the intent of rule 28, of our present rules when formulated.

MR. CANFIELD:—Hasn't the arbitration committee passed on that?

THE SECRETARY:—Yes, sir, they adopted it a year ago.

THE PRESIDENT:—No, not the arbitration committee, I don't think it has been before the arbitration committee.

MR. CANFIELD:—I think it has.

THE SECRETARY:—(reading) "As this suggestion was made to your club by the arbitration committee, and adopted by them"—so it must have been done last year.

THE PRESIDENT:—What is your opinion, Mr. McKenna? Do you think the arbitration committee has passed on that?

MR. MCKENNA:—It is my understanding that they have.

THE PRESIDENT:—I don't see why he should raise the question then?

MR. DOW:—I think that question has been before the arbitration committee.

MR. CANFIELD:—I feel pretty sure that the arbitration committee has ruled that you may bill for the brasses and pocket bolts in case of the moving wheels and axles on a defect card. I feel sure that the committee has made such a ruling. In order to settle the matter, if I may be permitted, I would move that the Secretary of this club be instructed to look up the arbitration committee's rulings, and see if they did not pass upon it, and, if so, to notify this club of the arbitration committee's action; and if not, to report to this club at its next meeting, for further discussion.

THE PRESIDENT:—If there is no objection I will so rule. Mr. Secretary, you will look that up.

THE SECRETARY:—I will correspond with Secretary Taylor, send this to him, and ask whether the arbitration committee has passed upon it.

MR. CANFIELD:—Yes, sir.

UNFINISHED BUSINESS.

On motion, in accordance with the recommendation of the Executive Committee, the request of the Brooks Memorial Hospital was granted.

MR. ADAMS:—I move that we have our next meeting at Niagara Falls.

MR. PERKINS:—I second the motion. Carried.

(On motion, adjourned.)

THE NEXT MEETING.

The next regular meeting of the Club, will be held at Niagara Falls, on Friday, May 8, 1903.

Harry D. Vought

Seretary.

IMPORTANT!

Notice to Members.

MAY MEETING TO BE HELD AT NIAGARA FALLS.

The next regular meeting of the Central Railway Club will be held at the **Prospect House, Niagara Falls, N. Y.,** on Friday, May 8, 1903.

In addition to the business session there will be a social programme, the details of which will be announced in the official call to be hereafter issued.

The following Committee of Arrangements has been appointed:

James Macbeth, M. C. B., N. Y. C. & H. R. R. R.;
A. M. Waitt, Yonkers, N. Y.;
C. W. Bradley, Manager Western New York Car Service Association, Buffalo;
L. H. Van Allen, Supt' L. V. R. R., Buffalo;
J. B. Morford, Supt. Canada Division M. C. R. R., St. Thomas, Ont.
F. W. Williams, D. M. M., D. L. & W. R. R., Buffalo;
B. M. Tate, Magnus Metal Co., Buffalo.

GEORGE W. WEST,
President.

HARRY D. VOUGHT,
Secretary.

CONSTITUTION AND BY-LAWS

AS REVISED AND ADOPTED APRIL, 1895

Amended March, 1897 **Amended March, 1898**
Amended November, 1898 **Amended March, 1901**
Amended November, 1901 **Amended September, 1902**

CONSTITUTION

ARTICLE I.

Name.

The name of this organization shall be THE CENTRAL RAILWAY CLUB.

ARTICLE II.

Objects.

The objects of this Club shall be the advancement and promulgation, by means of reports, papers, investigations and discussions, of knowledge concerning the construction, operation and maintenance of railroads and railroad equipment, and the cultivation of sociability among its members.

ARTICLE III.

Membership.

SECTION 1. The membership of this Club shall be composed of persons connected with any branch of railway service, locomotive or car manufacturing, or the manufacture or sale of railway supplies. Such persons may become members after making written application, by payment of the annual dues, and signing the Constitution and By-laws, or authorizing the Secretary to do so for them.

SEC. 2. Membership shall continue until written resignation is received by the Secretary, unless forfeited by non-payment of dues.

SEC. 3. Persons may be elected to honorary membership in this Club by the unanimous vote of the members present at any regular meeting, and shall be entitled to all the privileges of membership, but shall be exempt from the payment of the annual dues.

ARTICLE IV.

Officers.

The officers of this Club shall consist of a President, a Vice-President, and four Executive members. These officers shall constitute the Executive Committee.

ARTICLE V.

Election of Officers.

SECTION 1. The officers shall be nominated from the floor, and elected by ballot, at the annual meeting for the term of one year or until their successors are chosen.

SEC. 2. Any person regularly engaged in railway service shall be eligible to the office of President.

ARTICLE II.

Quorum.

At any meeting of the Club eleven members shall constitute a quorum for the transaction of business.

ARTICLE III.

Dues.

SECTION 1. The annual dues shall be two dollars, payable in advance on the second Friday in January of each year, of which one dollar shall be in payment of one year's subscription for the printed proceedings of the Club at the published price.

SEC. 2. At the annual meeting of the Club the names of those members whose annual dues are still unpaid for the year then ending shall be dropped from the roll, unless the Executive Committee shall organize an extension of time to be made including the March meeting, previous notice of at least thirty days having been given such members by the Secretary. The proceedings of the Club shall not be mailed to persons whose names have been dropped from the membership roll, and such members shall not be eligible for future membership until all back dues are paid.

ARTICLE IV.

Order of Business.

The order of business shall be as follows:

1. Roll call.
2. Reading minutes of previous meeting.
3. Remarks by President.
4. Announcement of new members.
5. Reports of standing committees.
6. Unfinished business.
7. New Business.
8. Reports of special committees and reading of papers.
9. Discussion of subjects for debate.
10. Topical discussions of questions submitted by members.
11. Appointment of committees.
12. Election.
13. Announcements.
14. Adjournment.

ARTICLE V.

Publications.

SECTION 1. The proceedings, or such portion thereof as the Executive Committee shall decide, of the regular meetings of the Club, shall be published (standard size, 6x9 inches), and mailed to the members of the Club and to the members of other similar Clubs with which exchange is made.

SEC. 2. The published proceeding of the first meeting, next following after the annual meeting of the Club, shall contain the Constitution and By-laws of the Club, together with a list of the officers and members.

ARTICLE VI.

Amendments.

Amendments to these By-Laws may be made at any regular meeting of the Club by a two-thirds vote of the members present, notice of such amendment having been presented in writing at a previous meeting.

SEC. 3. Any vacancy that occurs may be filled at any regular meeting by ballot, two names at least to be presented by a Nominating Committee of three to be appointed by the President at such meeting, due notice of the election having been given in the regular call for the meeting.

ARTICLE VI.

Duties of the Executive Committee.

The Executive Committee shall exercise a general supervision over the interests and affairs of the Club; they shall arrange the programme for meetings and entertainments; shall have authority to appoint a Secretary-Treasurer; authorize all expenditures of the Club, but shall have no power to make the Club liable for any amount beyond that which at the time of contracting same shall be in the hands of the Treasurer in cash, and not subject to prior liabilities. The Executive Committee shall audit the books and accounts of the Secretary and Treasurer.

ARTICLE VII.

Handling of Funds.

All funds of this Club shall be deposited in a reliable bank, which shall be approved of by the Executive Committee, and all payments on account of the Club shall be made by check signed by the Secretary and Treasurer, such payments being first authorized by the Executive Committee.

ARTICLE VIII.

No patentees, or their agents or agent for the sale of railroad supplies, shall occupy the attention of any Club meeting in the interest of the devices in which they are personally or financially interested, unless they are especially invited to do so by a majority vote of the members present, or by consent of a majority of the Executive Committee, and the article they represent forms a part of the subject for discussion at the meeting.

ARTICLE IX.

Amendments.

The Constitution may be amended at any regular meeting of the Club by a two-thirds vote of the members present, notice of said amendment having been presented in writing at a previous meeting.

BY-LAWS

ARTICLE I.

Meetings.

SECTION 1. The regular meetings of the Club shall be held at Buffalo, N. Y., on the second Friday of January, March, May, September and November, at 2 P. M., and a majority of the Executive Committee shall have authority to change the date and place of meeting if necessitated for any special purpose that in their judgement is for the best interests of the Club.

SEC. 2. The annual meeting shall be held on the second Friday in January at 2 P. M.

SEC. 3. The President may call special meetings at such time as he may deem expedient, or on the written request of at least at five members.

LIST OF MEMBERS

OF THE

CENTRAL RAILWAY CLUB

CORRECTED TO MARCH 14, 1903

If the title and post-office address opposite your name is incorrect, please notify the Secretary at once.

Name	*Representation*	*Address*
N. B. Ackley	C. Cl'k, S. M. P., M. C. R. R.	Detroit, Mich.
Thomas Aldcorn	G. S. Agt, Chicago Pneumatic Tool Co., 95 Liberty Street	New York City.
W. Alderson	G. I., Car Dept, G. T. R. R.	Toronto, Ont.
A. Allen	F., Mch. Shop, G. T. R. R.	Stratford, Ont.
Thos. Anderson	G. M., Youngstown Car Co	Youngstown, O.
S. D. Anderson	Standard Ry. Eqpt. Co., 122 Liberty St.	New York City.
C. G. Bacon	Corning Brake Shoe Co., 26 Cortlandt St.	New York City.
Otto N. Baird	R. H. F., P. E. I. Ry	Charlottetown, P. E. I., Canada
G. A. Barden	Chi. Pneu. Tool Co., Olney	Philadelphia, Pa.
H. F. Ball,	S. M. P., L. S. & M. S. R. R.	Cleveland, O.
E. D. Bangs	Bangs Oil Cup Co., P. O. Box 257	Milwaukee, Wis
J. A. Barhydt	M. M., B. R. & P. R. R.	Rochester, N. Y
Adam Bardsley	M. M., B. R. & P. R. R.	Bradford, Pa.
E. A. Benson	Supt. Mech. Dept. Pullman Company	Chicago, Ill.
Chas. F. Bingham	Bingham & Taylor	Buffalo, N. Y.
W. A. Blanchard	1412 Fisher B'l'd'g	Chicago, Ill.
J. G. Blunt	Chf. D., Am. Loco. Co., 70 W. 4th St.	Dunkirk, N. Y.
E. H. Bowman	L. V. R. R	Buffalo, N. Y.
S. J. Bowling	Sec. C. B. Hutchins & Sons, 1014 Majestic Bldg	Detroit, Mich.
Henry A. Boyd	G. A., Watson, Stillman Co., 125 Erie Co., B'k Bldg.	Buffalo, N. Y.
D. M. Brady	Pres., Brady Brass Co., 95 Liberty Street.	New York City.
Jas. B. Brady	71 Broadway	New York City.
H. S. Bradfield	Agt. Am. Bk. Shoe & F. Co., 170 B'way.	New York City.

Name	*Representation*	*Address*
J. A. Bradley	9 Oakdale Place	Buffalo, N. Y.
C. W. Bradley	Mgr. W. N. Y. Car Service Assn, Ellicott Square,	Buffalo, N. Y.
F. A. Brazier	A. S. M. P., R. S. N. Y. C. & H. R. R., Grand Central Station	New York City.
E. D. Bronner	S. M. P. & E., M. C. R. R.	Detroit, Mich.
A. B. Brown	West'house A. B. Co., 778 Ellicott Square.	Buffalo, N. Y.
David Brown	826 Mulberry Street	Scranton, Pa.
J. Alex. Brown	24 Park Place	New York City.
H. G. Brown	Brown Car Wheel Works	Buffalo, N. Y.
H. M. Brown	Brown Car Wheel Works	Buffalo, N. Y.
John T. Brown	V. P. and Mgr. Damascus Bronze Co.	Pittsburg, Pa.
W. J. Buchanan	A. M. C. B., P. B. & L. E. R. R.	Greenville, Pa.
C. L. Bundy	G. F., D. L. & W. R. R.	Dover, N. J.
E. G. Buchanan	Union Car Co., 26 Cortlandt Street	New York City.
G. Burgert	Supt. Ramapo Wheel and Foundry Co.	Ramapo, N. Y.
William T. Burton	G. F., L. S. & M. S. R. R.	Buffalo, N. Y.
C. J. Butler		Corning, N. Y.
H. M. Butts	Supt. Pas'g'r Equ't, N. Y. C. & H. R. R. R.	Albany, N. Y.
G. W. Bynom	E. H. F., L. V. R. R.	Auburn, N. Y.
S. J. Campbell	G. F., L. S. & M. S. R. R.	Collinwood, O.
David A. Campbell	Columbia Refrig. Co., 32 Broadway	New York City
L. T. Canfield	V. P., Stand'd Ry. Eq. Co., 122 Liberty St.	New York City.
H. M. Carson	S. M. P., Penn. R. R.	Buffalo, N. Y.
Fred. A. Casey	V. P. Ashton Valve Co., 271 Franklin St.	Boston, Mass.
Fred R. Case	Hoopes & Townsend	Philadelphia, Pa.
F. W. Chaffee	G. C. I., Car Dept., N. Y. C. & H. R. R. R.	Albany, N. Y.
H. P. Chamberlain	Manager Atlas Oil Works	Buffalo, N. Y.
E. Chamberlin	868 President Street	Brooklyn, N. Y.
C. T. Chapin	Pres., Rochester Car Wheel Works	Rochester, N. Y.
J. A. Chubb	Supt. Air Brakes, M. C. R. R.	Detroit, Mich.
Edward Cliff	Pres., Cliff & Guibert Co., 198 W. Broadway.	New York City.
W. E. Coffin	Natl. Mal. Castings Co	Cleveland, O.
G. Fred. Collins	B. M. Jones & Co., 143 Liberty Street.	New York City.
Betram Cole	Loc. Eng., 27 Spring Street	Buffalo, N. Y.
H. Corey		Petrolia, Ont.
Wm. J. Courtney	Peerless Rubber M'f'g Co., 16 Warren St.	New York City.
S. A. Crone	Pres. Buffalo Bk. Beam Co., 100 Broadway.	New York City.
Otis H. Cutler	Ramapo Iron Works	Hilburn, N. Y.
M. B. Cutter	S. G., L. V. R. R.	So. Bethlehem, Pa.
C. H. Dale	Peerless Rubber Co	New York City.
E. M. C. Davis	Niles Tool Works, 138 Liberty Street.	New York City.
Chas. H. Davis	M. E., Broad Exchange, 25 Broad Street.	New York City.
A. W. Davis	F., M. P. & C. Dept., G. T. R. R. Box 1316.	St. Thomas, Ont.
George Debevoise	Chilton Paint Co., 69 Cortlandt Street.	New York City.

Name	*Representation*	*Address*
W. C. DeArmond	Pres., Protectus Co., 1108-09 N. Am. Bldg.	Philadelphia, Pa.
H. Delaney	Brown & Co., 215 Pearl Street	New York City.
H. N. Demarest	G. C. I., Penn. R. R.	Williamsport, Pa.
W. L. DeRemer	W. Spencer Otis, Ry. Supplies, 903 Plymouth Bldg	Chicago, Ill.
P. R. Diamond	D. M., Magnus Metal Co.	Pittsburg, Pa.
S. K. Dickerson	M. M., L. S. & M. S. R. R.	Cleveland, O.
Frank S. Dinsmore	E. Mgr., *Ry. Age.*, 220 Broadway	New York City.
R. Donaby	F. C. R., N. Y. C. & H. R. R. R.	Niagara Falls, N. Y.
C. J. D. Donahoe	Chf. C., M. P. Dept., L. S & M. S. R. R.	Cleveland, O.
G. N. Dow	M. C. B., L. S. & M. S. R. R	Cleveland, O.
A. Dowdell	Valentine Varnish Co., 57 Broadway	New York City.
W. D. Drake	Drake & Weirs Co.	Cleveland, O.
O. W. Duntley	Chi. Pneu. Tool Co.	Chicago, Ill.
H. C. Edson	Pratt & Letchworth Company	Buffalo, N. Y.
Chas. W. Edgerton	L. Eng., N. Y. C. & H. R. R. R. 301 Swan St.	Buffalo, N. Y.
F. G. Ely	71 Broadway	New York City.
C. D. Ettinger	Murphy Varnish Co.	Chicago, Ill.
R. C. Fraser	U. S. Metal & Mfg. Co., 25 Broad St.	New York City
O. M. Foster	T. Eng., L. S. & M. S. R. R.	Collinwood, O.
C. A. W. Fritzsche	42 East Eagle Street	Buffalo, N. Y.
Fred. C. Ganson	L. Eng., Erie R. R., 524 No. Div. St.	Buffalo, N. Y.
W. H. Gardiner	Coal & Iron Exchange	Buffalo, N. Y.
George A. Gardiner	Revere Rubber Co., 59 Reade Street	New York City.
M. A. Garrett	G. A., F. W. Bird & Son, 1434 Monadnock Bldg	Chicago, Ill.
Chas. L. Gately	Mgr. Ry. Supply Dept. M. J. C. Spg. & Rubber Co., 10 Barclay Street.	New York City.
John Garvey	Lo. E., N. Y. C. & St. L. Ry, 1173 Seneca St.	Buffalo, N Y.
Arthur Gemunder		Columbus, O.
W. T. Goodnow	G. M. Cayuta Wheel & Fdry. Co.	Sayre, Pa.
C. D. Golz,	257 Adams Street	Buffalo, N. Y.
Charles A. Gould	Pres. Gould Coupler Co., 25 W. 33rd St.	New York City.
C. M. Gould	Gould Coupler Co.	Depew, N. Y.
W. S. Gould	Gould Coupler Co., 25 W. 33d Street	New York City.
Carl R. Green	Chi. Pneu. Tool Co., 445 Ellicott Sq.	Buffalo, N. Y.
B. E. Greenwood	G. F., L. S. & M. S. R. R.	Buffalo, N. Y.
P. H. Griffin	Pres. N. Y. Car Wheel Works, 12 German Insurance Bldg	Buffalo, N. Y.
J. P. W. Hackett	D. M., Magnus Metal Co.	Depew, N. Y.
Henry Hale	48–50 N. Sixth Street.	Philadelphia, Pa
William Hamillton	Erie Car Works.	Erie, Pa.
J. F. Harrigan	Fulton Iron & Eng. Wks	Detroit, Mich.
George H. Haselton	D. S. M. P., N. Y. C. & H. R. R. R.	W. Albany, N. Y.
Scott R. Hayes	Ry. Steel Spring Co., 71 B'way, R'm 816.	New York City

Name	*Representation*	*Address*
Cornell S. Hawley.	G. A., Con. Car H't'g & L't'g Co., Park Row Building	New York City
John Hawthorne...	M. M., L. V. R. R.	Sayre, Pa.
L. B. Heers.....	M. M., P. S. & N. R. R.	Angelica, N. Y.
B.A. Hegeman,Jr..	Pres. U. S. Metal & Mfg. Co., 25 Broad St.	New York City.
John M. Henry....	Ass't E. M. P., P. & E. Div., Penn. R. R.	Williamsport, Pa.
W. T. Henry.....	N. Y. Air Bk. Co., 66 Broadway	New York City.
C. S. Henry.....	N. Y. Air Bk. Co., 1401 Fisher Bldg.	Chicago, Ill.
J. G. Hendrickson,	46 Richmond Street	Philadelphia, Pa.
John Hewitt.....	Fore., Boiler Shop, N. Y. C. & St. L. Ry.	Conneaut, O.
H. H. Hewitt.....	Pres. Magnus Metal Co., 71 Broadway....	New York City.
S. Higgins.....	Supt. Mach'y, Southern Ry	Washington, D. C.
Charles Higham...	American Brake Co	St. Louis, Mo.
N. P. Hobart.....	Am. Brake Shoe & Fdry. Co., 170 Broadway.	New York City.
C. H. Hogan.....	M. M., N. Y. C. & H. R. R. R.	East Buffalo, N. Y.
W. L. Holman....	M. M., Penn. R. R...	Renovo, Pa.
W. C. Houck.....	129 Tonawanda Street	Buffalo, N. Y.
John Howard.....	D. S. M. P., N. Y. C. & H. R. R. R.	Depew, N. Y.
H. B. Howe.....	Gen. Wks. Mgr. Govt. Ry. Workshops..	Eveleigh, Sidney. New South Wales
Harry M. Hubbell.	Beckwith, Chandler Varnish Co., 71 Broadway	New York City.
C. A. Hunter.....	G. S., Peerless Rubber Co	New Durham, N.J.
F. P. Huntley.....	Sec. Gould Coupler Co., 25 West 33d St.	New York City.
W. J. Hurley....	R. F., W. Div., N. Y. C. & H. R. R. R.	Buffalo, N. Y.
S. D. Hutchins....	West'ghouse A. B. Co., 303 M. & M. Bk. Bldg	Columbus, O.
Edwin T. James...	M. M., L. V. R. R.	Wilkesbarre, Pa.
J. M. James.....	M. M., Penn. R. R.	Olean, N. Y.
Geo. W. Jennings.	G. M. Wicks, Refgr. Car Co., 328 Ellicott Square	Buffalo, N. Y.
E. Z. Jefferson....	S. M. Penn. Rubber Co., 1207 Empire Bldg.	Pittsburg, Pa.
F. Johnson.....	Supt. Buffalo Car Mfg. Co.	Buffalo, N. Y.
H. C. Johnson.....	Chas. Scott Spring Co	Philadelphia, Pa.
W. F. Jones	G. S. K., N. Y. C. & H. R. R. R.	W. Albany, N. Y.
B. M. Jones	B. M. Jones & Co.	Boston, Mass.
S. H. Jones.....	G. Mgr. Magnus Met. Co., 612 Fidelity Trust building	Buffalo, N. Y.
Emerson W. Judd.	Res. Ed., *Ry. Age*, 220 Broadway	New York City.
J. P. Kelly.....	Insp. N. Y. Air Bk. Co.	Watertown, N. Y.
George Keim.....	Supt. Car Shops, Atlas Works	Buffalo, N. Y.
W. H. Kelson.....	G. S. K., C. P. R. R.	Montreal, Quebec.
W. E. V. Kemp...	C. C., D. L. & W. R. R. Mach. Shops.	Buffalo, N. Y.
Fred. Kerby.....		St. Mary's, Pa.
J. G. Kiel.....	F. P., L. S. & M. S. R. R.	Buffalo, N. Y.
George F. Kissam.	Murphy Varnish Co	Newark, N. J.
W. B. Klee.....	Pres. & Treas. Damascus Bronze Co.	Pittsburg, Pa.

Name	*Representation*	*Address*
S. B. Keys	Agt. Con. Car H't'g & L't'g Co., 634 Park Row Building	New York City
Gottlieb F. Knaus.	Foreman M.C.R.R., Exchange St. Station.	Buffalo, N. Y.
E. Kopperman	F., B. R. & P. R. R.	Buffalo, N. Y.
P. J. Langan	A. B. I., D.L.& W.R.R., 355 Emmett St.	Scranton, Pa.
John S. Lentz	Supt. Car Dept., L. V. R. R.	Packerton, Pa.
O. P. Letchworth.	Pratt & Letchworth Co.	Buffalo, N. Y.
T. S. Lloyd	S. M. P. & M., D. L. & W. R. R.	Scranton, Pa.
E. J. McCarthy	Beals & Co.	Buffalo, N. Y.
H. C. McCarty	860 Rural Avenue	Williamsport, Pa.
Robert McKenna.	Sup't Car Shops, D. L. & W. Ry.	Scranton, Pa.
S. W. McMunn	Otis Steel Co., Old Colony Bldg.	Chicago, Ill.
J. McGrath	M. M., G. T. R. R.	Ft. Gratiot, Mich.
Wm. McWood	Supt. Car Dept., Grand Trunk Ry.	Montreal, Quebec.
Jas. Macbeth	M. C. B., N. Y. C. & H. R. R. R.	Buffalo, N. Y.
D. R. MacBain	D. M. M., M. C. R. R.	Jackson, Mich.
John Mackenzie		Cleveland, O.
W. G. P. Maclure.	A. M. E., Great Central R. R.	Gorton, Manchester, England.
G. E. Macklin	Spl. Agt., Pressed Steel Car Co.	Pittsburg. Pa.
W. H. Marshall	Gen. Supt., L. S. & M. S. R. R.	Cleveland, O.
Edward S. Marshall.	Am. Car & Fdry Co., Lincoln Trust Bldg.	St. Louis, Mo.
W. R. Maurer	Chf. D., B. R. & P. R. R.	Rochester, N. Y.
Joseph Maycock	Pratt & Lambert.	Long Island City, N. Y.
David Meadows	T. E., M. C. R. R.	St. Thomas, Ont.
R. B. Meany	A. S., Peerless Rubber Co.	New Durham, N. J.
L. C. Melsom	L. Egr. N. Y. C. & St. L. R. R., 207 Babcock Street	Buffalo, N. Y.
James A. Mellon.	C.D.,D.L.& W. R. R , 660 Hyde Park Ave.	Scranton, Pa.
J. C. Mengel	M. M., Penn. R. R.	Elmira, N. Y.
Merle Middleton	1070 Monadnock Building	Chicago, Ill.
A. F. Miller	Galena Oil Co	Franklin, Pa.
E. A. Miller	M. M., N. Y. C. & St. L. R. R.	Conneaut, O.
R. S. Miller	G. F. Car Dept. N. Y. C. & St. L. R. R., 93d St., & Jefferson Ave., Station S	Chicago, Ill.
W. B. Miller	Diamond Rubber Co.	Akron, O.
A. E. Mitchell	S. M. P., Northern Pacific R. R.	St. Paul, Minn.
R. W. Mitchener.	T. M., N. Y. C. & St. L. R. R.	Conneaut, O.
George E. Molleson	Gen. Mgr. Tyler Tube & Pipe Co., 39 Cortlandt Street	New York City.
E. P. Mooney	Ingersoll-Sargent Air Compressor Co., 503 E. Delevan Ave.	Buffalo, N. Y.
J. W. Mooney	U. S. Metal & Mfg. Co.	Buffalo, N. Y.
J. D. Murray	Ch.DraughtsmanCarDept.,D.L.& W.R.R.	Scranton, Pa.

Name	*Representation*	*Address*
Paul Myler	Mgr. Westinghouse Mfg. Co., Ltd	Hamilton, Ont.
E. C. Neal	V. P., Buffalo Wholesale Hdw. Co	Buffalo, N. Y.
A. B. Neill	G. M., Buffalo Car Wheel Fdry. Co	Buffalo, N. Y.
E. D. Nelson	E. M. P., Pennsylvania Co	Williamsport, Pa.
F. M. Nellis	Ins. Westinghouse Air Bk. Co., Asso. Ed. *Locomotive Engineering*	Havemeyer Bldg., New York City.
John D. Newton	Swan Finch Co., 151 Maiden Lane	New York City.
A. V. Newton	Con. L. S. & M. S. R. R. 519 No. Div. St.	Buffalo, N. Y.
Charles O'Connor	G. S. K., D. L. & W. R. R.	Scranton, Pa.
Thos. J. O'Donnell.	Arbitrator, Buffalo & Sus. Bridge Dist	East Buffalo, N. Y.
William Ogilvie	C. I., N. Y. C. & St. L. R. R.	Brocton, N. Y.
J. L. Osgood	Mgr., Buffalo branch Niles Bement Brake, Pratt & Whitney Co., Seneca & Wells Sts.	Buffalo, N. Y.
William Owens	N. Y. Air Bk. Co., 96 Chenango Street	Buffalo, N. Y.
R. H. Parks	M. C. B., M. D. T. Co	Dispatch, N. Y.
Le Grand Parish	M. C. B., L. S. & M. S. R. R., 6447 Yale Av.	Chicago, Ill.
J. C. Peabody	151 Maiden Lane	New York City.
J. F. Pendergrast	G. F., B. & O. R. R.	Grafton, W. Va.
H. H. Perkins	F. Agt. N. Y. C. & H. R. R. R., Ohio St.	Buffalo, N. Y.
J. R. Petrie	Box 52	Brantford, N. Y.
Edward A. Phillips.	Whitestone	Long Island, N. Y.
Charles F. Pierce	Care of Goodwin Car Co., 96 Fifth Ave	New York City.
Wilbur L. Pierce	B. M. Jones & Co., 159 Devonshire St	Boston, Mass.
W. A. Polk	Patterson, Sargent Co., 42 Hudson Street.	New York City.
L. R. Pomeroy	Spl. Rep., Ry. Dept. Gen. Electric Co., 44 Broad Street	New York City.
George A. Post	Pres. Stand. Coupler Co., 26 Cortlandt St.	New York City.
C. H. Potts	M. M., Penn. R. R.	Sunbury, Pa.
George E. Pratt	A. G. M. & Con. Agt., Niles Car & Mfg. Co.	Niles, O.
H. G. Prout	V. P., Union Sw. & Sig. Co., 143 Liberty St.	New York City.
C. S. Prosser	Peerless Rubber Co., 16 Warren Street	New York City.
L. F. Purtill	1207 Havemeyer Bldg., 26 Cortlandt St	New York City.
C. F. Quincy	V.-P. Ry. Appliance Co., Old Colony Bldg.	Chicago, Ill.
R. B. Rasbridge	C. C. I, Main Passenger Station	Reading, Pa.
A. H. Renshaw	Trojan Car Coupler Co	Troy, N. Y.
John N. Reynolds.	V. P., *Ry. Age.*, Monadnock Bldg	Chicago, Ill.
T. Rhodes	Car Foreman, G. T. R. R.	Fort Erie, Ont.
E. G. Rouse	F. C. R., L. V. R. R.	Packerton, Pa.
W. H. Rosevear, Jr.	Chf. Clk. Car Dept., G. T. R. R.	Montreal, Quebec.
C. E. Rood	Malleable Iron Works	Lancaster, N. Y.
W. H. Sanford	Am. Car & Foundry Co.	Buffalo, N. Y.
Chas. Scott, Jr.	Chas. Scott Spring Co	Philadelphia, Pa.
F. W. Sargent.	Chf. Eng., Am. Bk. Shoe & Fdry. Co.	Mawah, N. J.
William Seward, Jr.	A. S. K., Peerless Rubber Co.	New Durham, N. J.
C. A. Sherman	M. M., D. A. V. & P. R. R., 439 Wash. St.	Dunkirk, N. Y.
Harry W. Sheldon.	Standard Steel Wks., 71 Broadway	New York City.

Name	*Representation*	*Address*
J. W. Sheldon	R. F. E., Penn. R. R.	Renovo, Pa.
Chas. T. Shoen	Shoen Mfg. Co.	Pittsburg, Pa.
Chas. Shults	National Tube Co., Havemeyer Bldg	New York City.
T. Sills	Joint Car Inspector	Niagara Falls, Ont.
W. E. Silverthorne		N. Tonawanda, N. Y.
Angus Sinclair	77 Beach St	E. Orange, N. J.
J. R. Slack	S. M. P., D. & H. R. R.	Albany, N. Y.
A. W. Slocum	G. Supt. Keystone Car Wheel Co.	Pittsburg, Pa.
Ernest F. Slocum	G. Agt., S. C. H. & L. Co., 160 Broadway.	New York City.
Pemberton Smith	N. Y. Car Wheel Works	Buffalo, N. Y.
J. T. Smith	G. Y. M., L. V. R. R.	Buffalo, N. Y.
Willard A. Smith	National Malleable Castings Co.	Chicago, Ill.
S. L. Smith	National Malleable Castings Co.	Cleveland, O.
William M. Smith	Chilton Paint Co., 804 Tremont Bldg.	Boston, Mass.
W. W. Snow	Ramapo Wheel & Foundry Co.	Ramapo, N Y.
C. L. Snyder	C. C. M., P. Dept., Penn. R. R.	Buffalo, N. Y.
S. W. Spear	Supt. E. Buffalo Iron Works	Buffalo, N. Y.
S. E. Stout	Foreman N. Y. C. & H. R. R. R.	Clearfield, Pa.
Eliot Sumner	M. M., Penn. R. R.	Buffalo, N. Y.
E. H. Symington	T. H. Symington & Co.	Baltimore, O.
H. Tandy	Kingston Locomotive Works	Kingston, Ont.
B. M. Tate	Ass't to G. M., Magnus Metal Co., 612 Fidelity Trust Building	Buffalo, N. Y.
W. P. Taylor	Bingham & Taylor	Buffalo, N. Y.
H. G. Taylor	J. B. Sipe & Co., 90 & 92 Federal Street	Allegheny, Pa.
J. B. Terbell	Car Ac., Penn. Div., N. Y. C. & H. R. R. R.	Corning, N. Y.
A. F. Thayer	Loc. In. Wabash R. R.	St. Thomas, Ont.
W. O. Thompson	D. S. M. P., R. W. & O. R. R.	Oswego, N. Y.
W. A. Thornburg	Mgr. & Treas., Thornburg Coupler Att't Co.	Detroit, Mich.
B. E. Tilden	B. E. Tilden & Co., 1209 Monadnock Bldg.	Chicago, Ill.
George M. Treffts	Farrar & Treffts	Buffalo, N. Y.
Thomas Treleaven	M. C. B., G. T. R R.	London, Ont.
William Tunkey	L. E., L. S. & M. S. R. R., 489 N. Div. St.	Buffalo, N Y.
C. E. Turner	S. M. P., B. R. & P. R. R.	Rochester, N. Y.
W. C. Turner	Detroit Graphite Co., 840 Ellicott Sq.	Buffalo, N. Y.
H. N. Turner	Eastern Rep. R. R. Dept. Acme W. L. & Color Works, 2394 Seventh Avenue	New York City.
L. H. Turner	S. M. P., P. & L. E. R. R.	Pittsburg, Pa.
W. J. Trounce	Gen. Sales Agt., Goodyear Lumber Co.	Buffalo, N. Y.
Sidney S. Underwood	Ch. Draughtsman Car Dept., G. T. R. R.	Montreal, Quebec.
Allan Vail	D. S. M. P., Penn. R. R.	Buffalo, N. Y.
L. H. Van Allen	Supt. L. V. R. R.	Buffalo, N Y.
E. P. Vogels	Protectus Co., 1103 N. Am. Bldg.	Philadelphia, Pa.
John H. Vought	Ass't to S. M. P., L. V. R. R.	So. Bethlehem, Pa.
Harry D. Vought	Railroad Editor, *N. Y. Commercial*, 62 Liberty Street	New York City.
A. M. Waitt	3 Philipse Place	Yonkers, N. Y.

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George L. Waitt...	Ins. New Material, N. Y. C. & H. R. R. R., Exchange Street Station..	Buffalo, N. Y.
Shelton Weed.....	Weed & Co.....	Buffalo, N. Y.
George L. Weiss...	Mgr. Butler Drawbar Attach., Co., 139 Ingleside Ave.....	Cleveland, O.
George W. West...	S. M. P., N. Y. O. & W. Ry.....	Middletown, N. Y.
A. L. Whipple....	Curtain Supply Co., 2131 Park Row Bldg.	New York City.
F F. Whittey.....	G. F., Wabash R. R.....	St. Thomas, Ont.
F. W. Williams...	D. M. M., D. L. & W. R. R.....	E. Buffalo, N. Y.
C. R. Williams....	A. S. M. P., Penn. Div., N. Y. C. & H. R. R. R., 176 E. 2d Street....	Corning, N. Y.
E. A. Williams....	S. R. S., C. P. R. R.....	Montreal, Quebec.
Hugh M. Wilson..	President *Ry. Age*.....	Chicago, Ill.
J. L. Woods.....	1380 Old Colony Bldg.....	Chicago, Ill.
A. B. Wright.....	Galena Oil Co.....	Newport, Pa.
Calvin Yoemans...	G.F., N.Y.C. & H.R.R.R., 139 W. 4th St.	Oswego, N. Y.

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La Mott Ames.....		Batavia, N. Y.
Amos Gould.....	357 N. Division Street.....	Buffalo, N. Y.
F. B. Griffith.....	1049 Elmwood Avenue.....	Buffalo, N. Y.
John Kirby.....		Adrian, Mich.
J. B. Morford.....	Supt. M. C. R. R.....	St. Thomas, Ont.
Robert Potts.....	M. C. B., M. C. R. R.....	St. Thomas, Ont.
A. C. Robson.....	58 Park Street.....	Buffalo, N. Y.
T. Sutherland.....	U. S. Customs Dept.....	London, Ont.

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OFFICIAL PROCEEDINGS

Central Railway Club

Vol. 9 — May Meeting, 1903 — No. 3

PUBLISHED BY THE CLUB

Entered as second-class matter at the New York, N. Y., Post Office, February 21, 1899.

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OFFICIAL PROCEEDINGS

OF THE

CENTRAL RAILWAY CLUB

VOL. 9.
NO. 3. NEW YORK, May 8, 1903 { $1.00 PER YEAR 25 CENTS A COPY.

REGULAR MEETINGS AT BUFFALO: SECOND FRIDAY IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER, AT 2 P. M.

PUBLISHED IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER at No. 62 LIBERTY STREET, NEW YORK.

OFFICERS, 1903

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VICE-PRESIDENT, J. A. BARHYDT, M. M., B. R. & P. R. R., Rochester, N. Y.
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W. H. ROSEVEAR, Jr., C. C., Car Dept., G. T. R. R., Montreal.
L. R. POMEROY, Spl. Rep., R. R. Dept. Gen. Electric Co., New York.

NEXT MEETING, Friday, September 11, 1903.

THE MAY MEETING

NIAGARA FALLS, May 8, 1903.

The regular meeting of the Central Railway Club was held at the Convention Hall of the Natural Food Company, Friday, March 8,

1903, at 10 A. M., President George W. West in the chair. The members registered in attendance included the following:

F. D. Adams,	C. M. Hogan,	Charles O'Connor,
W. Alderson,	George W. Jennings,	Thos. J. O'Donnell,
Howard G. Brown,	W. E. V. Kemp,	Robert Potts,
H. S. Bradfield,	J. F. Knaus,	H. H. Perkins,
Bert Cole,	G. G. Keil,	T. Rhodes,
W. J. Buchanan,	E. Kopperman,	A. C. Robson,
J. A. Bradley,	S. B. Keys,	E. F. Slocum,
W. T. Burton,	L. A. Long,	C. A. Sherman,
H. M. Butts,	E. P. Mooney,	T. Sills,
L. T. Canfield,	Robert McKenna,	H. N. Turner,
F. W. Chaffee,	H. C. McCarty,	W. C. Turner,
R. Donaby,	M. J. McCarthy,	B. M. Tate,
H. N. Demarest,	D. Meadows,	W. O. Thompson,
R. C. Fraser,	J. B. Morford,	A. F. Thayer,
John H. Garvey,	James A. Mellon,	Thomas Treleaven,
F. C. Ganson,	J. Maycock,	William Tunkey,
C. R. Green,	J. G. Miller,	A. M. Waitt,
Arthur Gemunder,	W. R. Maurer,	George W. West,
Scott R. Hayes,	James Macbeth,	C. H. Weaver,
E. M. Hedley,	A. B. Neil,	F. F. Whittey,
B. A. Hegeman, Jr.	Gorton Nelson,	F. W. Williams,
W. J. Hurley,	William Owens,	Calvin Yeomans.

The visitors registered were: Benson E. Brown, Manager railway department Acme White Lead & Color Works, Detroit, Mich.; Percy M. Brotherhood and F. P. Smith, traveling salesmen of Manning, Maxwell & Moore, New York; C. H. Weaver, Buffalo; W. D. Cox, General Car Inspector L. S. & M. S. R. R., Cleveland, O.

THE PRESIDENT:—Gentlemen, please come to order. The first order of business is roll-call. The cards having been distributed, that will be dispensed with. The next is the reading of minutes of the previous meeting.

THE SECRETARY:— They have been printed and distributed, Mr. President.

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1041

THE PRESIDENT:—Next in order seems to be the remarks of the President. It is an old saying that all work and no play makes Jack a dull boy. The Central Railway Club has never been styled a gentlemen's club. I would not have you understand by that remark that I insinuate that its members are not composed of gentlemen, but I think anyone at all familiar with the affairs of the Central Railway Club will admit that it has been made up of working members. For that reason more than any other it accounts, I think, for some of our slimly-attended meetings. Our friends have given us the reputation of confining ourselves strictly to business. It is no uncommon thing to go to our meetings at Buffalo and ten minutes prior to the opening be able to see but half-a-dozen members. The same thing is true at its close. In ten minutes after the close of the meeting you can hardly find a member of the Central Railway Club, and our friends who like to do a little visiting with us shun these meetings on that account I think more than anything else. The contrary is true of the other clubs with which I am familiar. Take the New York Club, for instance. I believe that ninety per cent. of the members in attendance at the business meeting can be found in the banquet hall or the social meeting held after the business meeting. Some of your officers and members thought it a wise and good business proposition that we depart from our regular custom and take one day or one meeting day and mix a little pleasure with our business, and that is our object in meeting here to-day. If it shall serve the purpose which we hope, I am sure that its officers, and I think its members, will feel congratulated that we have taken this means of giving ourselves and the members a little pleasure. As our time is short we will devote the balance of it to the meeting. Next in order is the announcement of new members.

NEW MEMBERS.

THE SECRETARY:—The Executive Committee, Mr. President, passed upon the applications to-day of the largest number ever received, I think, at the spring meeting of the club, and there seems to be particular gratification in being able to announce first the election of Mr. John F. Deems. The complete list is as follows:

John F. Deems, General Superintendent of Motive Power,

PRATT & LETCHWORTH COMPANY, Malleable and Steel Castings

Rolling Stock and Machinery, N. Y. C. & H. R. R. R., New York City.

Charles E. Lucke, Ph. D., Mech'l Eng., Dept. Columbia University, New York City.

M. J. McCarthy, Master Mechanic Michigan Central R. R., St. Thomas, Ont.

George J. Duffey, General Foreman M. C. R. R., St. Thomas, Ont.

J. G. Miller, Locomotive Engineer B. R. & P. R. R., Buffalo, N.Y.

L. A. Long, Locomotive Engineer B. R. & P. R. R., Buffalo, N. Y.

C. D. Shaver, Agent L. S. & M. S. R. R., Angola, N. Y.

Gorton Nelson, Locomotive Engineer Erie R. R., Buffalo, N. Y.

E. M. Hedley, General Foreman N. Y. C. & H. R. R. R., Depew, N. Y.

C. E. Postlethwaite, Manager Sales, Central Department, Pressed Steel Car Co., Pittsburg, Pa.

W. H. Andrews, General Manager Pratt & Lambert, Buffalo, N. Y

J. H. McNulty, Assistant Manager Pratt & Lambert, Buffalo, N Y.

J. Parker Gowing, with Pratt & Lambert, Chicago, Ill.

F. P. Cheesman, National Paint Works, Williamsport, Pa.

The Secretary would take occasion to say that the veteran "Bill" Tunkey said that he would produce a dozen members this year, and he has kept his word.

THE PRESIDENT:—Under our Constitution, these members having been passed upon favorably by the Executive Committee, are now members of the Central Railway Club. The next order of business is Report of Standing Committees.

REPORT OF THE EXECUTIVE COMMITTEE.

THE SECRETARY:—The Executive Committee, at its meeting to-day was advised that fourteen members were suspended for non-

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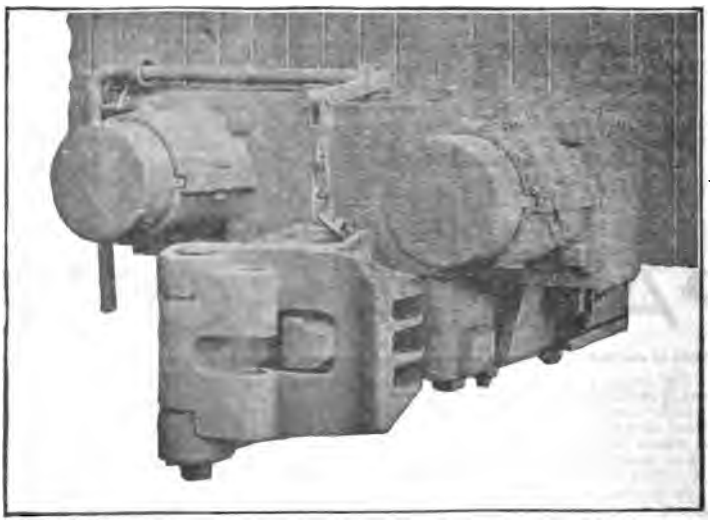

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payment of dues. The following letter was received from Dr. Lucke:

COLUMBIA UNIVERSITY, NEW YORK,
Mechanical Engineering Dept.
March 23, 1903.

Mr. H. D. Vought, Secretary Central Railway Club, New York City.

DEAR SIR:—The extended invitation of the Central Railway Club I received through your kindness March 17. This mark of the Club's interest is very gratifying to me and I will be pleased to accept for May 8. I hope that I shall be able to justify the expectations of the members and look forward with pleasure to a renewal of our short acquaintance.

Yours very truly,

CHARLES E. LUCKE.

In reference to the inquiry of the Car Foremen's Association of Toledo for the interpretation of Rule 28, the Secretary was directed to ascertain if the Arbitration Committee had not passed upon this question and the Secretary of the M. C. B. Association says: "There has been no case presented to the Arbitration Committee covering the point in question and therefore no decision rendered."

The Secretary of the Brooks Memorial Hospital acknowledges the action of the Club in permitting the diverting of a contribution for their elevator fund and in a subsequent letter says:

DUNKIRK, N. Y., April 16, 1903.

Mr. H. D. Vought, Secretary Central Railway Club, New York City.

MY DEAR MR. VOUGHT:—I am directed by the Board of Directors of the Brooks Memorial Hospital to thank you and your Club for your very considerate action in consenting to the change of your elevator donation into our General Fund. This change will make the money available for the practical uses of the Hospital and you may be sure that it will do more than $50.00 worth of good to somebody.

Very sincerely yours,

B. E. FARNHAM,

Secretary.

PRATT & LETCHWORTH COMPANY, Malleable and Steel Castings

Of the recommendations made by the Secretaries' Society with special reference to the exchange of printed proceedings the Secretary of that Society reports that all clubs have agreed to the basis of fifty cents per member for the reports of other clubs, with the exception of the Western, New York and Southern & Southwestern clubs, but the New York Club already has an arrangement of its own by which it has, for a year or two, charged one dollar per subscription per member which is just double what the secretaries recommended.

Prof. Goss of Purdue University has accepted an invitation to read a paper before the Club and will do so at our November meeting. At our meeting in January, Prof. W. T. Magruder of the Ohio State University is to give us a paper on "The Uses of the Gas and Gasoline Engines in Railway Work."

The Interstate Commerce Commission has asked the Club to take up for discussion a report made on safety appliances. This request will be complied with at our September meeting, under action of the Executive Committee to-day. The Secretary of the Commission having signified a readiness to supply members with copies of this report, a list of the members will be sent to him and the members receiving that report are requested by the Executive Committee to thoroughly inform themselves as to the recommendations and changes made in the report and come to the September meeting prepared to thoroughly discuss the same.

The Committee on Question Box have favored the Executive Committee with the following report to be presented to the Club at this time:

REPORT OF THE COMMITTEE ON QUESTION BOX.

To the President and Members of the Central Railway Club:

Your Committee on the Revival and Reorganization of the Question Box Department, beg leave to submit the following report and recommendations:

The Question Box Department of the Central Railway Club was organized, at the suggestion of the Executive Committee, November, 1900. At that time the idea was to provide a box into which members might deposit questions when attending the meetings. Questions were not to be signed by the propounders, so that members might not feel backward about asking any questions desired.

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Manager Railroad Department.

C. S. PROSSER,
Assitant Manager Railroad Department.

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REPORT OF THE COMMITTEE ON QUESTION BOX.

A committee was appointed to outline a method of procedure in inaugurating and conducting the "Question Box." This committee studied into the methods pursued by other railway clubs and reported, at March, 1901, meeting, as follows:

> "The Secretary shall send to each member of the Club a printed form for submitting questions, on which form space shall also be provided for an explanation of any difficulty or reason why the question is propounded. The replies shall be sent to the Secretary (unsigned if the member so desires), who will forward them to the Committee on 'Question Box.' These question blanks also to be had from the Secretary at any of the Club meetings.
>
> "The Committee will then classify the questions in order of their importance, rejecting any questions that may be improper for the Club to consider, and selecting one or more of the questions that may be most suitable to become the subject of a paper to be presented by whomsoever the President may select. Of the balance of the questions the Committee will select a number that will be printed and distributed in advance of a meeting, and which may be discussed at the meeting and form part of the printed proceedings, the Committee to see that enough questions are always before the Club to make the meetings interesting."

The report was accepted.

There were some questions presented at the May, 1901, meeting, which were not quite clear, and the reasons for the questions were not given. Unfortunately, none of the Question Box Committee were present. Considerable discussion followed and a rule was adopted requiring that any question submitted to the Question Box, afterwards going to the Executive Committee for their consideration, was to be laid over, unless the propounder was present and gave reasons for making the inquiry. At the same meeting another rule was adopted requiring questions presented at a meeting to be printed in the proceedings and discussed at a succeeding meeting; not more than four questions to be reported to any one meeting of the Club.

For some reason or other, since the adoption of the foregoing rules, the interest in the Question Box Department has lagged, until now it is practically "non est."

Therefore, to rejuvenate the Question Box, your Committee would earnestly recommend the following:

1st. That the Question Box Department still be retained, as it offers a means for the handling of subjects that any member may wish to bring up, and will have a tendency to interest members who

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would otherwise refrain from taking an active part in the proceedings of the Club.

2nd. That, as heretofore, it be under the supervision of a Question Box Committee, who are to classify the questions, rejecting any that may seem improper for the Club to consider. It shall be the duty of this Committee to see that the questions as presented to the Club are worded in a clear and concise manner, and are accompanied by reason or explanation of the particular phase of the question desired to be discussed; and otherwise to conduct the department as it has been in the past, with the exceptions as noted.

3rd. That all matters relating to the management of this department be referred to the above Committee before final action of the Club is taken.

4th. That printed blanks be furnished, on which all questions are to be written, a space being provided for a statement of the reasons for wishing the question discussed. On the back of the blank will be printed the rules of the Question Box Department, and such other information as may be deemed necessary to aid the propounder in conforming to the requirements of the Department.

5th. That it be left optional with the propounder whether or not he sign his name to the question. But all persons submitting questions are urged to sign the blank, in order that no question may be thrown out on account of not being clearly stated, or being in any other way defective, as by having the name it will enable the Question Box Committee to correspond with the propounder and get sufficient information to correct the defect.

6th. That the name of the propounder of any question is to be considered strictly confidential and is not to be given out by the Committee.

7th. That questions be sent either to the Secretary or to the Chairman of the Question Box Committee.

8th. Each question to be referred to a special committee to be appointed by the President, who will write up their individual ideas regarding same. In the notices for the regular meetings the questions in the Question Box to be brought up at such meetings should be stated, as well as the names of the members of the Committee to whom the question was referred.

9th. Not more than four questions are to be reported by the Executive Committee to any one meeting of the Club, their presentation and discussion to take place at a succeeding meeting.

In conclusion, it is the opinion of your Committee that, if the Question Box is not hampered by a complicated set of rules, but is handled in a simple manner, much benefit can be derived from it. Members should not only be urged, but encouraged, to submit questions. In the language of the Pacific Coast Railway Club, "It

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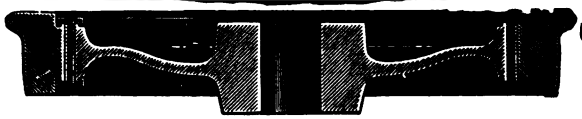

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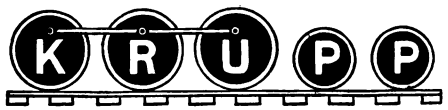

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is better to ask questions and get the ideas of other people, than to look wise, say nothing and go uninformed."

Respectfully submitted.

W. R. MAURER, Chairman.
C. H. HOGAN,
W. H. ROSEVEAR,
Committee.

Rochester, N. Y., May 8, 1903.

The Executive Committee decided to continue the entertainment committee which acted for this meeting, and as the chairman of that committee is now here, Mr. President, the Secretary will not undertake to anticipate him in what he has to offer.

THE PRESIDENT:—That seems to complete the reports of standing committees. Next in order, is Unfinished Business.

THE USE OF INDICATORS.

THE SECRETARY:—The unfinished business to-day, Mr. President, is the continuation of the discussion of Dr. Lucke's paper, and Dr. Lucke is present.

THE PRESIDENT:—Gentlemen, we have with us to-day Dr. Lucke who most of us have met on a previous occasion, and I now have the pleasure of introducing Dr. Lucke to those members who have not already had that pleasure. (Applause.)

DR. LUCKE:—To open this discussion, Mr. President and gentlemen, I would like to say that rather than have it a discussion of the paper as it appears before you, I should prefer to have it a discussion of the topic involved in the paper which is "The Use of Indicators," and any specific use may be included. To write a paper in which there shall be set down all the uses of an indicator is an impossible task and would easily fill a volume. Therefore, in the paper that has been presented to you there are a few little topics outlined which were selected with a view to their suggestiveness, with no attempt whatever to give a complete and exhaustive treatment of the subject.

I have had one or two requests, I have had a great many in fact, from men who were operating engines of various sorts, power-plant engines, locomotive engines, marine engines, to interpret their cards,

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and in about one case out of four I can do it, but in all the other cases I cannot and nobody else can. I do not mean to say that I am as good as everybody else, because I am not, but in nearly every case in which a card is presented for interpretation a whole lot of very important details are omitted, and unless the man who took the card presents with that card all the details necessary for its interpretation, nothing more than a guess can be made. About the only way to properly interpret a card is to do it on the spot, with all the details fresh in mind, with all the facilities for making the variations to prove your guess, because the first opinion is no more than a guess; on the spot, with all the details in mind, I say, and all the facilities for proving the truth or falsity of the first guess. That is the proper way to interpret a card. The use of an indicator is a very much wider, broader thing than mere interpretation of cards with a view to correcting valve settings and I have tried to point that out in the paper. I now leave the subject open for discussion by you.

THE PRESIDENT:—The subject is now open for discussion of these questions. I think the Doctor would be very glad to answer any question that might be offered. I have just suggested to Dr. Lucke that I think the action of the members of the Central Railway Club has proven the wisdom of the subject being brought out. The gentleman who suggested that a paper be read on this subject said that he thought very few men connected with the locomotive department were at all familiar with it, and the indications are that we are all a little backward about starting this discussion, I have asked Dr. Lucke to wont start the ball rolling himself.

DR. LUCKE:—For quite a long time the indicator was used for the purpose for which it was invented by Watt for the setting of valves and I think everybody who has ever used the indicator very much for the setting of valves has written something about it and so possibly that subject we might pass over unless you care to discuss it. Just to say something on the subject, I would like to describe a couple of cards I took from my machine. We have down at Columbia a Baldwin compound, and possibly the drawing of these cards on the blackboard might suggest some question to you. I

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have a series here showing variable cut-off. That is the primary difference between the cards. You will notice also as I draw the cards that there is more than a variable cut-off. There are various other features which vary with the variable cut-off. This is a high

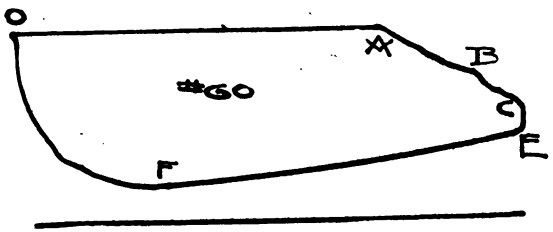

Fig I

pressure card, head end on the right-hand side, (Draws cards on blackboard. See Fig. I.) in which A is the point of cut-off. Fig. II

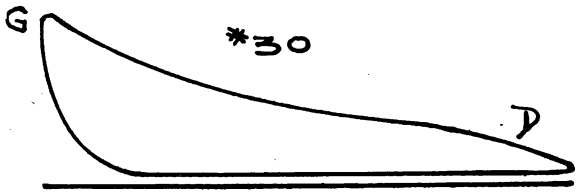

Fig II

is the low pressure; good steam line card, perfectly straight, good steady lines, are found on every card, no matter what the speed; we ran her up to speeds which would correspond to about 50 miles an hour. The expansion line, B, in every case fairly well defined, longer here than here. (Indicating.) At C is quite a sharp turn which is lacking at the low pressure at D, showing quite rounding. The sharp turn indicates there that the release or exhaust opening was good and broad and pressure went right down straight. If release had been delayed and port

was opened very slowly to this corner would appear sharp, like Fig. III, and then round off like X Y, but if although

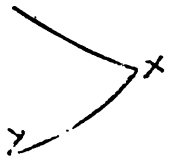

Fig III

delayed, when it did open, it opened good, pressure would fall and the line come down like Fig. IV. On the return stroke

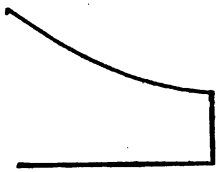

Fig IV

the back-pressure line of the high pressure card E F is a descending line; a line of lowering pressures which just corresponds to the admission line along G D on the low pressure. This is pretty regular on all cards showing a good clear opening, no obstruction. The compression line for HP cylinder F O is a very regular, pretty curve. We do not find that on every card. On Fig. V the H. P. card for

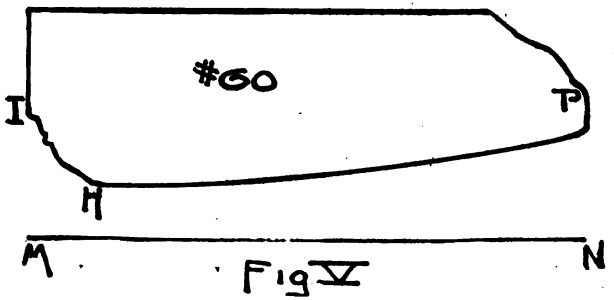

Fig V

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later periods we have H I instead of having a nice regular smooth curve. Here we not only have waves and little kinks, but instead of rising steadily the pressure stops rising at a certain point near I and the line gets flat on top. That is significant; it simply means that the exhaust valve leaks. That is the first thing you would hit upon. There may be some other thing to cause the same result but that is the first thing one would hit upon. The exhaust valve is closed, and exhaust prevented now; the piston still coming back, causes the rising pressure to I where it suddenly stops, because when it reaches this much it is high enough to force steam over the bridge and let it get out. The little steps which you see on these cards are due to the fact that the indicator wanted oil, and nothing else.

MR. MELLON :—Would not that be true if the steam leaked past the piston rings ?

MR. LUCKE :—Yes, but just at that time, near the end of the stroke on one side is a pressure I M, while on other side of the piston there is a pressure NP to NQ which may be higher than on this side, so that it is not likely that steam is leaking past the rings. On the low pressure cards, Figs. II and IV there is regular admission and expansion release; at K and D where the curve changes direction, changes from concave upward to concave downward, and a good clear exhaust opening with constant 5 pounds back-pressure which increases as throttle is opened, and tending to jump up and down and dance. The compression rises to about half the initial pressure on H P card Fig. V, and to about equality in Fig. I

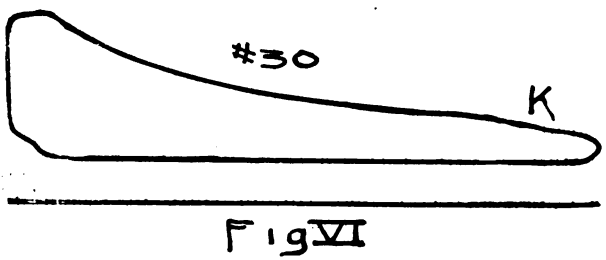

Fig VI

where the steam valve closes earlier. If the steam valve closes earlier the exhaust valve must close earlier also. The result is a higher and longer compression line, compressing in this case

to a high pressure, at least equal to the initial pressure. There is also a little peculiarity brought out here, there is a little straight end at O. Suppose that instead of having on top of the valve a certain pressure of steam the valve was held rigidly down to its seat by any means whatsoever. If that were true, pressure would have risen like Fig. VII, to the end of the stroke, then dropped to

Fig VII

the steam pressure, but it didn't get as high as the steam pressure, as the valve permitted a forcing out into the steam space, giving a little flat portion, the flat portion indicating that at the end of one stroke and the beginning of the return the same pressure existed in the cylinder. This point is well shown in the low pressure card Fig. VIII by students and they very often slip up on noting down

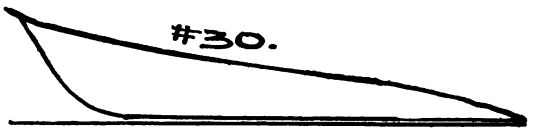

Fig VIII

conditions under which the things were taken. But, not knowing what was going on just at that time myself, I would say that that was a leaky steam valve, that the pressure of steam during the expansion was higher than it would be if it were a nice expansion line, pressure being higher during expansion than was due to a simple expansion; simply was leaking past the steam valve into the cylinder during the expansion period and boosted it up. The motion along the seat seems to have tightened it up, stopped the leaking at

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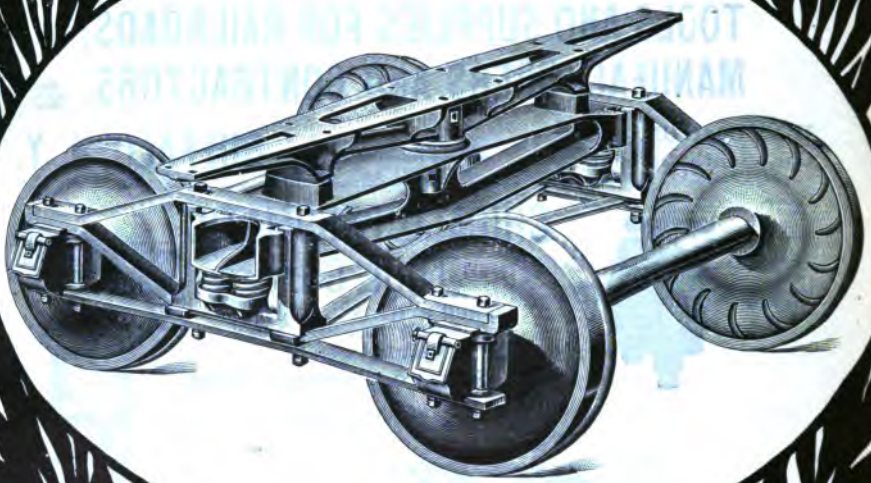

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some point there, or decreased it at any rate and allowed the thing to drop faster, as it should have. The low pressure cards are very uniform, very much nicer cards, very much more uniform cards than I have ever obtained on stationary engines.

That is about all I shall say about these cards. They do not vary much on high-speed. I tried that, starting up pretty slow, then opening up wide. The pressure during the time the admission valve was open would stay up nicely, good and high and long. I have never been able to run this machine fast enough to get a falling steam line during the admission period. I can get that on most any stationary engine except a Corliss. Most slide-valve engines will show signs of this.

So far we have been judging valves from the superficial results on indicator card. I haven't said anything about balancing the two ends. On this engine they will balance. Another card drawn on this side would appear just the same as this. I did superimpose them. A lot of other things beside the mere setting of a valve, and judging the conditions of cylinder valves and gear from the card, come up in connection with the use of the indicator. One that I had occasion to look into lately was the size of the steam chest. That is an important matter. I have said that a falling admission line is due to restricted port-area. It may be. It generally is, on slide valve-engines. But it doesn't do to jump at conclusions. If the steam chest is a very small steam chest, and the steam-pipe were too small a steam-pipe, the cylinder draws steam so fast that there results a falling pressure in your steam chest when valve is wide open. When you have a falling line like that you can determine positively whether it is due to restricted port-area or due to too small steam chest and steam piping, by putting the indicator on the steam chest. If during the admission period steam pressure falls, and at the end of the period of admission it rises again and stays up except during the admission period the pipe and chest are too small. This is a case where the indicator was not applied to the judging of the setting at all. These are questions on steam work, and of late many very important questions on gas-engine work are being solved with the indicator in just the same way. Two of the most important of these questions are the setting of the mixture valves and the ignition point to get the most work from the gas.

Gases will vary with the origin of the gas, and the nature of the gas, and that, in turn, varies in localities. Gas for gas-engine use varies in heating power from 90 B T U' S per cubic foot up to as high as a thousand gas ten times as rich in one case as in another, or having ten times as much heat in a cubic foot in one case as there is in the other. To get the best results from the gas is a problem that cannot be solved in any way except by the indicator. I have met men setting up gas-engines who said they could do it by a sort of an experience method. They cannot do it, and always get it wrong, where they are dealing with an unknown gas. One can do it with the indicator, however. Suppose we had the air and gas lines to the engine piped up and we were sure that when we started the fly wheel moving there would be drawn into the cylinder a mixture of air and gas in, we don't know what, but some proportions. We start at first with no gas on, turn engine over, turn a little gas on, keep on turning over, nothing happens, keep on turning over until by and by an ignition results. Leave the valve right there, let the engine run and take a card. We might get a card like Fig. IX. I will first draw a very nice card, I mean a card showing

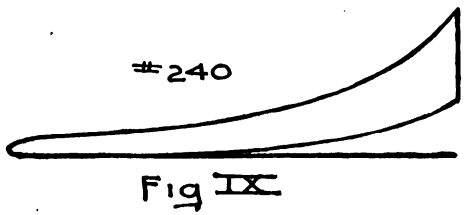

Fig IX

he proper periods. Suppose we got instead of this card on that first firing position of the gas valve something like Fig. X, it is quite

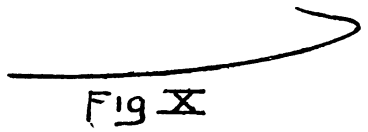

Fig X

possible to get that. What do we know by that right away? We know that the mixture is not right. The combustion line starts at

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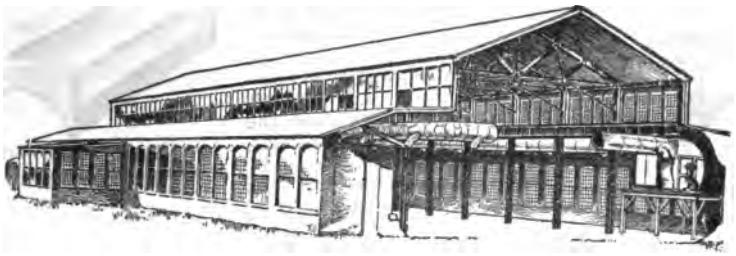

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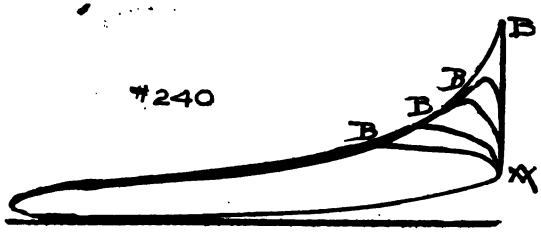
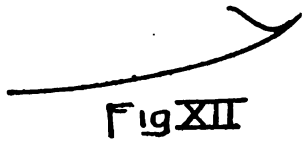
the end the of compression A, so the ignition is all right or very nearly so, but the pressure does not rise. We know by experience that various proportions of air to gas will cause various pressures. Too much gas will lower the maximum, too much air will also lower it, mixture with neutral gases will also lower it, blowing steam in will lower it. But there is only one proportion of air to gas which in that cylinder will give the maximum pressure rise. Every other proportion, too much gas, too much air, neutral added, anything of that sort, will always lower it. As we do not get a rapid rise, we know the mixture is burning slowly and we know also, therefore, that the mixture cannot be right. We began with no gas at all, and obtained an ignition after admitting a little gas. Therefore, we haven't enough gas yet. Admit more gas and you will find if you do that pressures will rise like A B Fig. XI and you get a series of

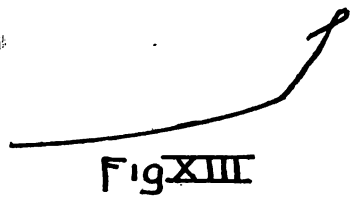


lines crossing, coming out about the same point C. Suppose tha tyou had done that and kept on adding more and more gas and seeing combustion lines rise and rise and rise. You might ask where is it going to stop? Keep on admitting gas and the lines will go down again, then stop. Put the gas valve back to the point where combustion lines were lightest. Now you have got your mixture as near right as you can make it on this run. The next thing is to make absolutely sure your ignition is right. Suppose that when this best mixture was found there was noticed a little kink in the

corner A Fig. XII, the maximum compression pressure here was



reached and passed before the pressure began to rise from the heat addition. Suppose instead of having it like this it came out somewhat like B Fig. XIII. What does that mean? It means the



charge was fired too soon; before the maximum pressure compression was reached; the pressure began to rise quickly showing an early combustion. It is better to ignite a little too soon so far as the areas of the cards are concerned, but for other reasons it is better to ignite late. When ignition is very early there results a very hard bang at the end of the stroke; the piston will come up, as it were, against a stone-wall with almost exactly the same effect on the cylinder as has water in a steam cylinder.

Those are the two points in the running of an engine that must be settled by the indicator and can be settled in no other way, absolutely in no other way. In the paper, I there refer to some other things which could be found out by the indicator on gas engine work; also to one or two things on compressors and pumps, ice machines also are included in the air compressors. That will serve to refresh the matter in your minds and perhaps suggest some questions.

MR. MELLON:—Doctor, in some cards taken on a locomotive carrying 300 pounds of steam I observed the irregularity in the compression line which you illustrated extended up within 10 pounds of the top of the card or to 190 pounds, the steam on the opposite end of the piston was only 60 pounds, I want you to explain if the piston rings were leaking why that pressure couldn't go past the piston? Here is a copy of the card (presenting card to Dr. Lucke which he copies on the black-board.)

DR. LUCKE:—Certainly it could.

MR. MELLON:—Well, that is the question I asked you before.

DR. LUCKE:—Yes? Well, then I was wrong. Of course it could. The question is why, when there is a compression pressure, for example, something way over 100 pounds and, 60 pounds, at release on the other side of the piston, why could not the steam leak past the piston and cause this falling off to compression line? It can. Of course it can

MR. MELLON:—There is another question. On one of your diagrams in your paper the steam chest pressure curve has a very perceptible drop at both ends of cards, forward and back stroke.

DR. LUCKE:—Double acting engine, you know, will do that. (Draws card.) That is about it. It looks very much as if this line was drawn as the card was drawn, pressure going down, when the cylinder took steam, then cut-off chest pressure rose up, high until it got here, and then it dropped again when the other end began to take steam. There was a little oscillation due to probably the spring, in making these loops, but you will find that when the cylinder was not taking steam, pressure was rising; when it began to take steam, pressure dropped.

MR. MELLON:—I noticed the maximum is about at half stroke.

DR. LUCKE:—The maximum is about there (indicating). It took about that long for it to fill up each time from the too-small pipe. (Explains drawings.)

MR. MELLON:—What is your opinion of the indicators having reduction right in the instrument?

DR. LUCKE:—I don't know. I don't like them myself. I will

tell you why. It doesn't make any difference at what speed you use these things they will always give trouble. Of course, they are best at low speeds. Let me draw one. (Draws.) There is a very long string, and for any string, no matter how long or how short it is, there is a certain period of vibration; if it should get in syncronism with its connection you can't knock the wave out of it and you have got everything crooked from that cause. You may stiffen your spring but you cannot eliminate the wave; it is not so plain, but the wave is there; and that means that at times this indicator drum has not traveled as far as the piston; other times it is a little bit ahead, and on the whole all careful deductions are rendered useless, absolutely useless. I imagine though that for comparing the two ends of a cylinder, the device would be all right because there would be just about as much of an error on one side as there would on the other provided you took both cards at the same speed.

MR. MELLON:—I did use a guide.

DR. LUCKE:—Even then it was not satisfactory, was it?

MR. MELLON:—No.

DR. LUCKE:—I like to use a rigid connection all the way down, right up to within four or five inches of my indicator. I have a piece of eighth pipe screwed into an ordinary eight-inch pipe hanger which is made in this way: (draws diagram). On gas engine work a rigid wooden rod, I have used them as long as ten feet, as shown in the paper, supported, is about the best thing that ever happened.

THE PRESIDENT:—Mr. Waitt, do you feel like taking part in this discussion?

MR. WAITT:—Mr. Chairman, I don't know as there is anything I can add to what Dr. Lucke has said in his paper and in his remarks. It carries me back to a very interesting experience I had about 21 years ago, my first experience indicating a locomotive. We were running at what I thought then was a very high speed, 48 or 49 miles an hour on the front of an engine going over the Lynn marshes in Massachusetts, on a new engine we had gotten out; we were quite proud of it, but the indicator showed one defect in it that was corrected in subsequent engines: and as a result of the test, we found we were requiring too much steam in the cylinder for the size

of the dry-pipe that we used to carry the steam, and I have learned in my experience to have a good deal of respect for the steam indicator, and I believe that it is used on railroads far too little. If a car of grain comes into Chicago or to Buffalo a man does not hesitate before he buys it to have an inspector go and find out what is inside of it. He puts down the testing tube and gets a sample, and the indicator practically does the same thing for the hidden workings of the steam engine or gas engine. Three years ago, at one of our large shops on the New York Central, a new superintendent came and he saw they had some old fashioned stationary engines. He wanted to find out what they were doing and put the indicator on and found out that we were only getting about sixty per cent. out of the power of one of the stationary engines that it was capable of producing. Numerous instances of this kind can be shown showing the value of the indicator. To provide for setting the valves square is only a small part of its value. It is the only way really that you can find out authoritatively the correctness of the design of the steam-working parts of a locomotive or stationary engine or a gas engine, and I think it is very fortunate that Dr. Lucke has given the members of the Central Railway Club this able paper and especially this very interesting, familiar talk and description that comes perhaps more closely to the thought and minds of the members present than the paper did at first. I surely for one have been greatly interested, and I hope that it may be the means of creating a greater interest in the use of the steam indicator, especially in railroad circles where it is surely of incalculable value if it is made use of.

DR. LUCKE:—At the last meeting one of the members remarked that he had taken a set of cards with and without lubrication, which showed vastly differing steam consumptions under otherwise equal conditions, and he said at the time he would show them to me. If he is here I would like to hear more about them. On marine work, particulary that which goes in the navy, small generating sets are tested in the Brooklyn Navy Yards and other navy yards dry; not a drop of oil admitted to the cylinders. That is for the purpose of keeping the condensers clean on board ship. They have automatic governors to maintain a constant speed because the generators supply light. These automatic governors regulate the steam per stroke according to the load, and naturally the engine friction increases, as

it will without lubrication, the steam consumption will increase with lack of lubrication, other conditions being the same. I do not quite see how on a locomotive that applies. There is no automatic governor there. And I would like to know more about these cards showing varying consumptions, with, in one case, the cylinder well lubricated, and in the other case not.

MR. MELLON :—I made similar tests, Doctor. We cut down the lubrication about one-half and the cards that I took at the time showed it only affected one end of the cylinder, as I illustrated on that sketch. I took about ten cards at once—that is the pencil run over the card about ten times.

DR. LUCKE :—Here is a set of cards presented in which it seems that the pressures are higher on one side, the cut-off about the same on all judging from that, but the initial pressures differing, becoming lower in certain cases and lowest at the time when lubrication was least, I think?

MR. MELLON :—That is right.

DR. LUCKE :—Now, why? Why should that happen? All the periods are the same. It happens on one end of the cylinder only, the lubricator, I suppose, being up in the cab, not individual cylinder lubricator?

MR. MELLON :—No.

DR. LUCKE :—Just feeding the oil to the dry pipe.

MR. MELLON :—Yes.

DR. LUCKE :—Here then are shown a series of cards pretty hard to explain.

MR. MELLON :—Understand, the pencil traversed both ends of card the same number of times.

DR. LUCKE :—Yes. Now, what could cause that? A simple change in initial pressure. It is the only thing that occurs to me. Suppose the steam entered in such a way that the oil was projected towards one end, the other end would be running dry.

MR. MELLON :—The oil is conveyed in a pipe, outside the boiler, down into the steam chest.

DR. LUCKE:—Down into the steam chest, of course, but I say, on the assumption that it entered not on such a plane but some other way, either this way or that, it might project the oil more toward one end than the other and it might be that when the maximum amount of oil was supplied it would be enough to go over the whole surface, whereas when the oil was cut down low it could only get over one-half, leaving the other half dry. Suppose the other half were dry, how could it be possible to get lower initial pressures in the cylinder? If we imagine the thing was so dry as to cause a little rumbling, trembling and jumping on the seat, as you very often see on a dry bearing, particularly a slide, that would tend to lift the valve a little bit when the valve was over here and allow steam, when it should be coming in here, to also jump over the bridge and go out at the exhaust. If one end was rumbling up a little bit during the admission period, steam is going in the cylinder all right but also going out the exhaust at the same time by jumping over the bridge, being allowed to jump over the bridge when the valve was jiggling up and down on a dry seat. That is the only explanation I can think of. Without being able to say just how the oil gets more in one end than the other, if we assume it did get more in one end than the other and one end ran dry, the point would be explained, I think.

THE PRESIDENT:—Also frequently find the outer edge of the seat, the whole length of it, worn down more than the inner seat.

DR. LUCKE:—Oh, yes. I have seen that on stationary boilers.

THE PRESIDENT:—Mr. Hogan, do you care to say anything on the subject?

MR. HOGAN:—I do not know that I could say anything that would be very intelligent on this subject, Mr. President, for the reason that I am not familiar enough with the indicator, but I know it brings out and has brought out at times on our road, many points and assisted us in finding the cause of improper distribution of steam and squaring valves getting better service from the locomotive. We have found that by the use of the indicator that great improvements were made by enlarging the exhaust nozzle, which showed

relief of back-pressure, and I do know from the little experience I have had that we should use the indicator more than we do for the benefit of the locomotive department at large.

THE PRESIDENT:—Haven't you also noticed, Mr. Hogan, in your examination of valve seats, the conditions that I mention, that one end of the valve seat would be worn more than the other, one bridge?

MR. HOGAN:—Yes, I have, but I do not think that it is due to improper distribution of oil.

MR. WEST:—No.

MR. HOGAN:—It may be that through neglect of the fireman or whoever is looking after the lubricator, has allowed the valve to get dry, simply dry enough to catch on one end, and then lubrication takes place, but it would be too great to prevent that part of the seat from cutting further and allow the steam to pass over the bridge just as the Doctor has illustrated, but the other bridge would remain smooth as it did previous to the opposite seat cutting, or bridge, rather, but I think the lubrication as it passes down through the top of the steam chest is universally distributed. I don't see how it could be otherwise.

THE PRESIDENT:—There is another thought that has just entered my mind in connection with this matter—a good many of the old Schenectady engines that had a receiving port from the steam opening in one or both sides of seat?

MR. MELLON:—Both ends, so the pressure would be the same on both sides of the valve.

REORGANIZATION OF THE QUESTION BOX.

THE PRESIDENT:—Well, if there is nothing else under this head we will declare the discussion closed, unless Dr. Lucke has something else he would like to say? The next in order is from the Committee on Question Box. The Secretary has a message from Mr. Rosevear saying that he will not be present, and I will ask Mr. Maurer to present the report.

MR. MAURER:—Mr. President; The report as read expresses our idea of the way to handle the Question Box Department. There is nothing more that I can add to it.

REORGANIZATION OF THE QUESTION BOX.

THE PRESIDENT:—What is the pleasure of the Club in regard to the recommendation of the Committee on Question Box?

MR. MOONEY.—I move it be adopted, Mr. President.

(Seconded.)

THE SECRETARY:—Mr. President, I have heard some comment made upon the recommendation that it be left optional with the propounder to sign his name to the question, but "all persons submitting questions are urged to sign the blank in order that no question may be thrown out on account of not being clearly stated or in another way defective" (reads from report). It has been suggested that if a member did not wish to sign his name to a question the Committee to whom it was referred, if not satisfied with the amount of information given, could announce that the propounder was requested to give further information to the Committee, and in that way, if he was indisposed to disclose his identity, he could still proceed in an anonymous form.

THE PRESIDENT:—A motion to adopt the report of the Committee has been made and seconded. Before putting the question I would like to have the views of the members regarding it. Personally I am opposed to making the member propounding the question sign his name. There are a great many reasons why it is unnecessary. I think the object of the question-box was to give members holding subordinate positions in particular an opportunity of asking questions and some of those question might antagonize their superior officers, and I believe that the objection which the Committee raised to drawing out from that member some points could be just as well overcome with an anonymous question as with the signature of the person propounding a question. The Committee say in their report that these matters will be treated strictly confidential. We all know what "strictly confidential" means. If I had charge of a department and a member of this Club or any other organization should put a question before this Club that antagonized my interest, I'll risk but what I could find out who that party was if he signed his name. We want the question discussed, we want the question-box to go through, we want it to go through successfully, and it will only

go through successfully by each member who is interested in it giving us his opinion.

MR. HOGAN:—Mr. President, the object of your Committee asking that the name of the party presenting the question be sent to the Committee and trying to guarantee that it wouldn't go any further, was in cases where the question was not thoroughly understood or could not be put before the meeting in a manner that we would understand what points the questioner wished to bring out, and in those cases we might ask the member who presented the question for further information.

THE PRESIDENT:—Couldn't you do it if he didn't sign his name?

MR. HOGAN:—We could not. We would have to throw it out.

THE PRESIDENT:—I do not so understand it.

MR. HOGAN:—If he didn't sign his name we would not know where the question came from.

THE PRESIDENT:—It could be arranged, as the Secretary suggested, that the announcement be made that the question was not satisfactory and that other information be furnished.

MR. THOMPSON:—I think this idea of a man being afraid to sign his name to any question that he might ask appears to me as being rather absurd and in this twentieth century, in this great and glorious country, a fellow has a right to ask questions, has a right to sign his name to them, and it don't make any difference how ignorant the question is or whom it is going to antagonize. I don't believe there is a railroad man in this country at the present day who is going to give a fellow a rap on the head for asking a question.

THE PRESIDENT:—We would like to have a full expression on this subject, gentlemen.

MR. PERKINS:—Mr. President, I was at the meeting when it was brought up, the question of signing the name. I have heard consid-

erable discussion on the question of the question box. What you desire is to have questions asked. If you organize a box for gentlemen to drop questions into the box, if the question is too indefinite enough to bring up before the club it is a simple matter to give no further reference to it. If the one who dropped it in finds no reference has been made to it, he can ask it again, he can keep asking it. The idea that I have of the question box is to get somebody to ask questions and with as few restrictions as you can put on it. Why you make any regulations at all I do not see. Set the question-box on the table and ask them to fill it.

THE PRESIDENT:—I would say for the benefit of the members, on this subject, Mr. Thompson's experience and mine are entirely at variance. I have held some very subordinate positions and I know that certain recommendations and suggestions have been offered by myself and other men in subordinate positions and men have lost their standing, men have been put in the background, held back by their superior officers for bringing up those questions.

THE SECRETARY:—Mr. President, the Secretary feels disposed to remain in the background, but he thinks the members should keep this fact in mind; in the Secretary's office there is a stack of blanks about that high (indicating) which have never been used since the change in the regulations of the Question-Box requiring a member to sign a question he propounded, We have never had a question from that day to this. Is it wise to continue on that basis or to adopt a new one which will bring in the questions? Before the change was made we had quite a number of questions and a decided interest was shown in the Question-Box; since signatures were required the Question-Box has been dead.

MR. MAURER:—Mr. President, I believe that if the committee's recommendation No. 5 be read carefully, it will be found that the committee does not say that the propounder *must* sign his name, but would like to have him do so if he would. If he felt disinclined to do so, no harm would be done. It is the opinion of your committee, however, that it would be best for all concerned to have the blank signed.

REORGANIZATION OF THE QUESTION BOX.

THE PRESIDENT:—If there is nothing further to offer, the motion before the Club is that the recommendations of the committee be adopted.

(Carried.)

THE PRESIDENT:—The next in order is the report of special committees. The chairman of the entertainment committee will now make a report.

MR. MACBETH:—It seemed to be very gratifying to all concerned to find we have so large a membership attending this meeting. At the last meeting it was agreed that a little recreation would be a benefit to all, and I think it is confirmed in the attendance to-day. The suggestion has been made that we want something in a similar line for the next meeting. It would be a very good plan to make a trip to the Lackawanna Steel Company's plant, near Buffalo. I believe every member would enjoy it very much both as a matter of knowledge and curiosity. We could go via the lake front by boat, landing at the steel plant and coming back in the afternoon; or, perhaps it would be better to have the meeting in the morning, and take the trip after luncheon. Of course this is only a suggestion.

MR. MOONEY:—I make that as a motion, that the next meeting in September include a trip to the Lackawanna Steel Plant in Buffalo. (Carried.)

THE PRESIDENT:—I think we are under obligations to the Entertainment Committee for this attractive programme of to-day which they have prepared for us, and I will appoint the same members for an entertainment committee for the September meeting, they having arranged this programme so acceptably.

It has been moved and seconded that the next meeting include a trip to the Steel Plant near Buffalo.

(Carried.)

THE SECRETARY:—Mr. President, it seems to me that some acknowledgment is due to the Natural Food Company for the

courtesy that we have received at their hands to-day in the use of this beautiful hall and the attention that they have offered to give and have given the club during its stay at Niagara Falls. I would move that a proper resolution be prepared and spread upon the minutes and a copy be transmitted the officers of the company.

MR. MACBETH :—I second the motion.

(Carried.)

THE PRESIDENT :—I wish to say that Mr. Olmsted said that at any time the club can have the benefit of these rooms and the use of this hall.

THE SECRETARY :—I do not wish to make too many motions but I would like to suggest that a motion, thanking Dr. Lucke for what we have received from him in the way of instruction and benefit from his coming twice to our meetings might possibly be in order at this time.

MR. MOONEY :—I make such a motion.

MR. WAITT :—I second the motion.

(Carried.)

THE SECRETARY :—What will we do with this request of the Car Formens' Association which we have been carrying for several months, asking for an interpretation of Rule 28 which has not been passed upon by the Arbitration Committee, as we supposed at our last meeting?

THE PRESIDENT :—Notify them that the Arbitration Committee has not passed upon it and the Club doesn't care to.

THE SECRETARY :—That is the only unfinished business.

MR MOONEY :—I move that we adjourn.

Seconded and carried.

Adjourned.

THE NEXT MEETING.

The next meeting of the Central Railway Club will be held at Buffalo on Friday, September, 11th, 1903, and a trip will incidentally be made to the plant of the Lackawanna Steel Co., near Buffalo.

The arrangements for the day will be announced when the customary call is issued.

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Harry D. Vought

Secretary.

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Central Railway Club

Vol. 9 September Meeting, 1903 No. 4

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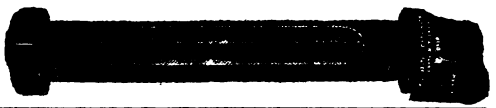

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OF THE

CENTRAL RAILWAY CLUB

VOL. 9.
NO. 4. NEW YORK, Sept. 11, 1903 { $1.00 PER YEAR 25 CENTS A COPY.

REGULAR MEETINGS AT BUFFALO: SECOND FRIDAY IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER, AT 2 P. M.

PUBLISHED IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER at No. 62 LIBERTY STREET, NEW YORK.

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NEXT MEETING, Friday, November 13, 1903.

THE SEPTEMBER MEETING

HOTEL IROQUOIS,
BUFFALO, Sept. 11, 1903.

The regular meeting of the Central Railway Club was held at the Hotel Iroquois, Friday, September 11, 1903, at 10 A. M., with

W. H. Rosevear, Jr., of the Executive Committee, presiding in the absence of President West, whose arrival was delayed by a late train. The members registering at the business session or later were:

H. G. Brown,
J. A. Bradley,
H. S. Bradfield
A. B. Brown,
C. W. Bradley,
H. A. Boyd,
Bloss P. Corey,
S. J. Campbell,
W. L. DeRemer,
G. N. Dow,
R. Donaby,
George J. Duffey,
H. N. Demarest,
Edward Elden,
S. R. Fuller, Jr.,
Amos Gould,
C. D. Golz,
Arthur Gemunder,
F. C. Ganson,
F. T. Hyndman,
G. H Haselton,
C. H. Hogan,
S. D. Hutchins,
Elmer E. Harris,
John Howard,
J. Hackett,
T. J. Hassett,
James J. Lowery,
W. E. V. Kemp,
G. F. Knaus,
E. Koppermann,
L. A. Long,
James Macbeth,
J. B. Morford,
R. S. Miller,
L. C. Melson,
John G. Miller,
M. J. McCarthy,
E. P. Mooney,
A. V. Newton,
A. B. Neill,
J. L. Osgood,
Thos. J. O'Donnell,
William Owens,
H. H. Perkins,
Robert Potts,
T. Rhodes,
W. H. Rosevear, Jr.,
A. C. Robson,
C. A. Sherman,
Thomas Sills,
A. R. Stacey,
S. W. Spear,
William Shone,
B. M. Tate,
Thomas Treleaven,
W. C. Turner,
William Tunkey,
F. W. Williams,
George W. West,
George L. Waitt,
Calvin Yeomans.

The visitors registered were P. P. Barten and T. V. Fowler.

CHAIRMAN ROSEVEAR:—Gentlemen, we all regret very much that our President is not with us to-day, but he will be here when we go to visit the plant of the Lackawanna Steel Company after luncheon.

The roll-call will be dispensed with as the attendance-cards have been supplied to each member on which they will inscribe their names.

The reading of the minutes of the previous meeting will also be dispensed with as they have been printed and are in your hands, unless there be some objection to such procedure. There being no objection they will stand as printed.

Speaking for Mr. West, we are very glad indeed to see so many

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1041

present, and we trust that the meeting this morning will prove of mutual benefit to each of us.

The Secretary will now read the list of new members.

NEW MEMBERS.

The Secretary announced the names of the following new members:

W. S. Carter, Editor and Manager *Locomotive Firemen's Magazine*, Indianapolis.

W. P. Steel, Coffin & Megeath Supply Co., Somerville, Mass.

James J. Lowery, Machine Foreman, Michigan Central R.R., St. Thomas, Ont.

A. R. Stacey, Chief Clerk Mechanical Department, Michigan Central R.R., St. Thomas, Ont.

George Carr, Gang Foreman, Michigan Central R.R., St. Thomas, Ont.

Bloss P. Corey, Galena Oil Co., Petrolia, Ont.

S. R. Fuller, Jr., Gould Coupler Co., Depew, N. Y.

John F. Symington, The T. H. Symington Co., Baltimore, Md.

Elmer E. Harris, W. H. Foote & Co., Buffalo, N. Y.

Edward Elden, General Locomotive Inspector New York Central & Hudson River R.R., Albany, N. Y.

L. T. Johnson, Machine Shop Foreman, N. Y. C. & H. R. R.R., Buffalo, N. Y.

THE CHAIRMAN:—Next will be the reports of standing committees.

THE SECRETARY:—The executive committee not having a sufficient number present for a meeting has not held a business session. The Secretary had very little for them at this time any way. Since our last meeting a communication has been received from the Natural Food Co., replying to our acknowledgments of their courtesy, in which they say:

NIAGARA FALLS, N. Y., May 25, 1903.

Mr. Harry D. Vought, Sec'y Central Railway Club, New York City.

DEAR MR. VOUGHT:—Your favor of May 23rd, addressed to the Company, is received, and we thank you very much for your kind words relative to the use of our hall at the time of your meeting on May 8th. We were very glad, indeed, to have you with us at that time, and trust you may see your way clear to have, at least, one meeting a year with us, if not more. We shall be very glad, indeed,

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to entertain you any time we can in that way, and you may feel at perfect liberty to call upon us for the use of our hall any time you so desire.

Yours very truly,

THE NATURAL FOOD COMPANY.
E. F. OLMSTED.

That is all the routine business, Mr. Chairman, with the exception of the report of the meeting of the Society of Railway Club Secretaries, held at Saratoga in connection with the annual conventions. (The Secretary then gave a synopsis of the report.)

THE CHAIRMAN:—With regard to the report from the Society of Railroad Club Secretaries, if it is your wish, as is customary, this report will be printed in the regular monthly proceedings for this month. There ought to be a motion brought before the meeting that the assessment of $10 for the ensuing year to the secretries' society be paid.

MR. DEMAREST:—I move that it be paid.

Carried.

SOCIETY OF RAILWAY CLUB SECRETARIES' MEETING.

Saratoga, June 26, 1903.

The society of Railway Club Secretaries met in annual session at the United States Hotel and was called to order by Vice Chairman Joseph W. Taylor of the Western Railway Club. Roll call showed the following representation :—

New York Railroad Club.—D. M. Brady;
Western Railway Club.—Joseph W. Taylor;
Central Railway Club.—Harry D. Vought;
Southern and Southwestern Club.—A. J. Merrill and W. L. Tracy;
Railway Club of Pittsburg.—John D. Conway.

In the absence of some of the members it was agreed to defer the transaction of regular business until June 27, at 11 A. M.

A. J. MERRILL,
Secretary.

Saratoga, June 27, 1903.

The Society met pursuant to adjournment and was called to order

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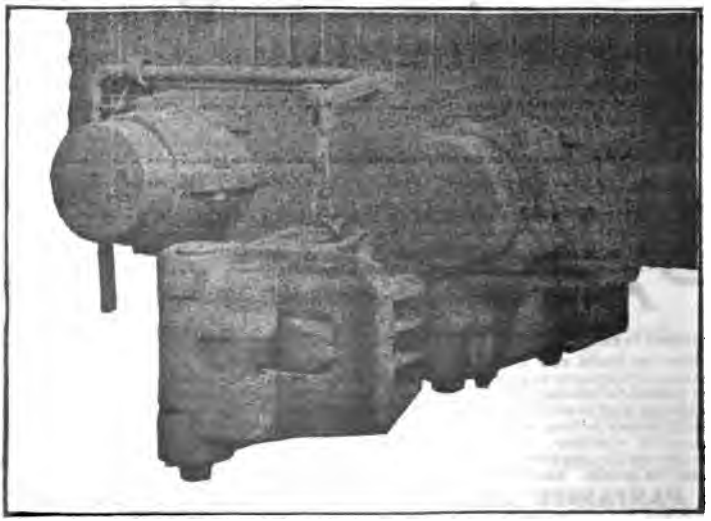

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by Chairman E. L. Janes, of the New England Club. Present, Messrs. Taylor, Brady, Conway, Vought and Tracy, Mr. Brady stating that he was acting as proxy for Mr. F. M. Whyte, of the New York Club.

On motion of Mr. Taylor, the duties of secretary pro tem were assigned to Mr. Vought, owing to Secretary Merrill being obliged to return home. The minutes of the meeting of 1902 were approved.

On motion of Mr. Taylor, the Iowa Club was admitted to membership subject to payment of the customary fee of $5.

Under a motion by Mr. Tracy, the Richmond, Va., Club was admitted on the same condition.

Mr. Taylor moved to amend the rules of order so as to provide that the date and time of future meetings shall be held subject to the call of the Chair, that the election of officers shall be the last order of regular business at the annual meetings of the Society and that presidents and first vice presidents of clubs that are members of the Society, shall, during their respective terms of office, be enrolled as associate members of the organization with all the privileges of active members except voting at the election of officers. These were agreed to and ordered submitted to letter ballot for ratification and adoption.

The report of the Secretary-Treasurer showed total receipts of $82.46, and disbursements aggregating $8.50, leaving a balance on hand of $73.96.

Mr. Conway moved that the Chairman be a committee of one to provide a gold membership badge of appropriate design, such badges to remain the property of the members after their retirement from active membership. Carried.

Mr. Vought moved that Mr. Brady be elected an honorary member of the Society and presented with membership badge in recognition of the fact that he was the first man to be elected secretary of a railroad organization and that he is the founder of the Society. Carried.

Mr. Brady tersely expressed his appreciation of the honor conferred upon him and at the same time availed himself of the opportunity to invite the secretaries to be the guests of the Executive Committee of the New York Club at the luncheon served in connection with their meetings.

The per capita assessment upon the various clubs for the expenses of the Society was fixed at $10 for the ensuing year.

The acknowldgements of the Society were voted to the Supply Men's Association for extending to its members the courtesies of the annual conventions and to Mr. A. M. Waitt and Mr. George W. West, ex-presidents, of the American Railway Master Mechanics' Association for their kindly and thoughtful interest in prompting this recognition of the Society.

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Mr. Taylor, in behalf of the Executive Committees of the Master Car Builders' and Master Mechanics' Associations, asked that the subjects scheduled for the next annual conventions be made, as far as practicable, a matter of committee reports and discussions by the various clubs.

On motion of Mr. Brady it was ordered that this recommendation be made as suggested.

The New England Club recommended that the Secretaries append to printed proceedings a schedule showing subjects discussed by sister clubs at their last preceding meetings. It was agreed that notification cards of meetings be exchanged by members in order to facilitate the carrying out of this proposition.

Representatives of Clubs that had adopted the rule of charging members for reports of sister clubs reported that it operated to the satisfaction of their respective organizations.

There being no further business it was agreed to defer the election of officers until Monday, June 29, at 4 P. M. to which time adjournment was taken.

HARRY D. VOUGHT,
Secretary pro tem.

Saratoga, June 29, 1903.

The Society met pursuant to adjournment at the United States Hotel, and was called to order by Chairman E. L. Janes, the members responding at roll call being as follows:—

New York Railroad Club.—D. M. Brady.
Central Railway Club.—Harry D. Vought.
Western Railway Club.—Joseph W. Taylor.
New England Railroad Club.—E. L. Janes.
Northwest Railway Club.—D. Van Alstyne, President.
Southern & Southwestern Railway Club.—W. L. Tracy, ex-President.
Railway Club of Pittsburg.—J. D. Conway.
Canadian Railway Club.—W. H. Rosevear, Jr.
St. Louis Railway Club.—E. S. Marshall, Executive Committee.
Richmond, (Va.) Railway Club.—J. F. Walsh, President.

At the suggestion of Mr. Van Alstyne and on motion of Mr. Conway it was resolved to publish an index of subjects discussed by the various clubs since June 1902, a sufficient number of copies to be furnished to each club in time for distribution to its members in advance of the September meetings.

It was further agreed that after the changes in the rules of the Society had been submitted to letter ballot, a revised edition of the Society's prospectus should be issued and distributed.

There being no further routine business before the Society the

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election of officers followed with the following result and after a vote of thanks to the retiring officers the meeting adjourned subject to the call of the chairman.

Chairman.—Joseph W. Taylor.
Vice Chairman.—J. D. Conway.
Secretary and Treasurer.—Harry D. Vought.

HARRY D. VOUGHT,
Secretary-treasurer.

THE QUESTION-BOX.

THE CHAIRMAN:—The Secretary has drawn your attention to these blanks that have been provided whereby questions may be sent to the Question-Box. I would very earnestly recommend this matter to members of the Central Railway Club and ask that they send in questions to the committee through the secretary so that we may be able to have them for discussion at our future meetings. We have found in club work that the state of the Question-Box is always an indication as to the life of the club. The more questions that are sent in the more interest members are taking in the club, and, therefore, the more the club is prospering. I have much pleasure, Mr. Secretary, in handing you the first question in connection with this matter.

THE SECRETARY:—The proper course for this will be to refer it to the Committee on Question-Box, of which Mr. Maurer is Chairman.

THE CHAIRMAN:—Is there any unfinished business, Mr. Secretary?

THE SECRETARY:—No unfinished business, Mr. President.

THE CHAIRMAN:—Any new business?

THE SECRETARY:—No new business.

THE CHAIRMAN:—Reports of Special Committees and reading of papers.

REPORT OF THE COMMITTEE ON REVISED RULES.

THE SECRETARY:—Mr. President, the Committee on Rules, of

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which Mr. O'Donnell is chairman, has completed its work and filed its report, printed copies of which have been sent to members. I have learned, to my regret and surprise, that some members have not received the notices sent out for this meeting. Very good evidence of the fact that they were sent out is the limited surplus here, and I want to add that I took pains to personally take those notices to the post-office. The mailing was properly done and the fault must be in the post-offices through which members receive their mail.

THE CHAIRMAN:—What is you pleasure? Shall the chairman read this report or will you take it as printed? The chairman is here and will be glad to answer any questions that may arise in connection with it, should you see fit to ask them.

THE SECRETARY:—This report has been framed differently from any report that has ever been presented, and it was sought by the Executive Committee to get an expression of opinion with an explanation from the members of the committee as to just what the changes were and what they signify, their effect, etc., and the committee has certainly carried out its work in an admirable manner. I believe this is one of the most valuable reports in that respect that has been presented. It has been customary, I think, to take these sections up *seriatim* and they are passed if no comment or question is offered.

THE CHAIRMAN:—Just as the members see fit. We can take up each article and if the explanation is not satisfactory or as full as the members would like to have it, why, it is your privilege to say so. If you like, we will take up each section; or, if the report be acceptable to all the members, you could accept the report as printed—whichever way you would like—without discussion.

MR. HUTCHINS:—I move it be taken up in sections, Mr. President.

MR. DEMAREST:—I second it.

Carried.

MR. O'DONNELL:—Mr. President, I think it has been customary

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not to allow the discussion of the rules and proposed changes to appear in our proceedings?

THE SECRETARY:—At times it has and at times it has not. If the club sees fit to decide that the discussion is not to appear then it is not taken.

MR. O'DONNELL:—Well, personally, I think inasmuch as there is so much diversity of opinion, it would be wise not to allow the discussion to appear in our proceedings. I do not see what value it would be to the outside world. The rules are there and they explain themselves. That is my individual opinion. I make a motion to that effect, Mr. President.

Seconded and carried.

(The club then considered the report of the Committee on Rules.)

Your Committee appointed to present a report on the Revised Rules of Interchange to take effect September 1, 1903, present the following:

Rule 4.—The addition of rule 41 which covers cars intended to be equipped with metal brake-beams and so stencilled if found with wooden beams. The reason for this change is on account of this rule being placed under the proper heading of defects which should be carded

Rule 35.—The addition of side doors to this rule as an owner's defect is simply the suggestion of the past three or four years by many railroad clubs that side doors should de included in this rule.

Rule 39.—The addition of side doors to this rule is simply to conform to rule 35 and therefore does not give the receiving line the privilege of calling for defect cards as is done at the present.

Rule 64.—The addition of the words "No wheels to be applied to foreign cars that the dates cast show them to be over six years old." The reason of this change in the opinion of your Committee is on account of the age of the wheels making them of less value when over six years old.

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Rule 69.—The following addition to this rule "Air brake hose applied to foreign cars after July 1, 1904, shall be considered as wrong repairs unless they are made in accordance with M. C. B. specifications and are so labeled." This change in the opinion of your Committee was on account of maintaining a standard specification on air hose throughout the country.

Rule 71.—The word "must" is placed in this rule instead of the word "should" making the rule read "cars undergoing extraordinary repairs such as sills, resheathing, roofing etc., *must* be reweighed, etc." In the opinion of your Committee this change makes it obligatory to reweigh and restencil instead of optional as heretofore.

Rule 72.—The addition of the words "of journals" between the words "the diameters of" and "such axles." In the opinion of your Committee the reason for this change is on account of maintaining the standard of the journals irrespective of the centers and the wheel seat providing, of course, that all measurements will fully come up to the M. C. B. requirements.

Rule 73.—This rule is added to the present rules as a new paragraph to read as follows: "When two or more cars chained together, or any cars which require switch chains to handle them, are delivered at an interchange point, the receiving road shall deliver to the delivering road at the time, an equivalent number of switch chains of the same size as the chains so used on the cars delivered, or, in lieu thereof, furnish a defect card for such chains." In the opinion of your Committee this new rule was added for the purpose of protecting chains that are interchanged on cars with double loads to which at the present time, little or no attention is paid, thereby causing great annoyance and loss at interchange points.

Rule 81.—Changed to read "or to the requirements of rules 55 to 77 inclusive." This is on account of a new rule, *i.e.*, 73.

Rule 82.—Changed to read "55 to 77 inclusive." This change is the same as the previous rule.

Rule 87.—Changed to read "and with an additional charge for all labor for each pair of wheels and axles removed from all *arch bar* trucks of $1.75 and from all *solid pedestal* trucks of $2.00" The reason for this change in the opinion of your Committee was on account of the difference in labor due to the construction of the trucks mentioned in removing wheels.

Rule 92.—The addition of the words "to car" added to the price of air hose complete. The interpretation of this means that the three

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been brought up by the Trainmen's Union and will be thoroughly discussed and passed on there, so that so far as we are concerned, of course we will have to be guided by the decision of the Government. In the meantime, if any of the members would like to talk about the act which will be brought up in the United States legislature, or wish to offer any motion, we will be very glad, indeed, to have a full and free discussion. It has been explained by the secretary that the only point in connection with the law—first, is that the equipping of locomotives and tenders with grab-irons has been extended from October 1 to 15; and then again there is a good deal of misunderstanding as to what is required and how the grab-irons shall be applied. Members are free to discuss the matter of how these irons should be applied, and how much time is still required for the completion of the work. Personally, I have not seen a copy of the act.

THE SECRETARY:—Secretary Moseley of the Interstate Commission wrote me that he had sent a copy to every member of this club whose name I had given him. Of course, only those of men in the railroad service were sent, as they are the ones most interested. It was assumed that it was not a matter that concerned supply men.

THE CHAIRMAN:—If members feel free to discuss this matter now we will be glad to have them do so. If not, perhaps it will be as well to refer it to the next meeting.

THE SECRETARY:—I would suggest the appointment of a committee, Mr. President, to take up the subject and present an expression of opinion, and then that will probably provoke the right sort of discussion. Evidently we are not going to get it to-day.

THE CHAIRMAN:—What do the members think of the appointment of a committee on the subject?

MR. DEMAREST:—I move the discussion be deferred until our next meeting, and in the meantime a committee be appointed to consider the matter so as to bring it forward for proper discussion.

Seconded and carried.

THE SECRETARY:—That completes the committee reports, Mr. President, with the exception of that of the Committee on Entertainment, which Mr. Macbeth will give when he arrives.

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MISCELLANEOUS BUSINESS.

THE CHAIRMAN :—Anything as to the appointment of committees ?

THE SECRETARY :—No committees outside of the appointment of the Committee on Safety Appliances.

THE CHAIRMAN :—I think we better leave the appointment of that committee to President West.

THE CHAIRMAN :—There is nothing under the head of elections. Shall we declare a recess for a little while in order that our President may, perhaps, be here and Mr. Macbeth, or shall we close the meeting ?

At the suggestion of Mr. Morford a recess was declared until 12 o'clock. On re-assembling the chairman expressed regret that President West was still unavoidably absent. Mr. Macbeth having arrived was asked to report for his committee.

MR. MACBETH :—Mr. President, the arrangements for this trip are as follows : Leave the foot of Main street at 2 o'clock sharp. We will go by boat to visit the Lackawanna steel plant. We will leave the steel plant at 5 o'clock. This, I think, will be satisfactory to all, as it will give us about two hours to visit the different points of interest.

THE CHAIRMAN :—We have heard Mr. Macbeth's announcement of the outing. I am sure we are all very glad, indeed, to accept the invitation and go out to the Lackawanna steel plant. Is there anything else before the meeting ?

THE SECRETARY :— You know, Mr. President, the secretary sometimes has to have the last word. I want to impress upon the members of this club—perhaps it has already been by force of circumstances—the wisdom of the policy of the administration of this year in providing something more than the business sessions of the club as being positive proof that it will bring members to the meetings. We have never had such meetings in two years as we have had this year, and it occurs to me, while listening to Mr. Macbeth, that upon the principle of two heads being better than one, the members of this club ought to think of what can be arranged in the way of entertainments and make suggestions to the Executive Committee. The

secretary believes he is not overstepping the bounds in making this suggestion. The Executive Committee, in the earnest desire they have to build up the organization to as high a standard as can be established, should have the coöperation of the members and make suggestions. And the same way in regard to the special features. It gives me very great pleasure to say to the members that Prof. Goss of Purdue University will give you a paper at the November meeting. In January, Prof. Magruder of Ohio University will give you another. After that arrangements will have to be made with regard to future papers. When you reflect on the high standing of the men you have had here so far, and that you will have men of this character hereafter, it should be evident that the club is establishing a reputation that it never previously had. It will go a long way toward bringing members to meetings and to induce others to become members of the club. You have had Dr. Luckie of Columbia University, who was with you twice; Prof. Breckenridge of Illinois, and Prof. Goss of Armour University, Chicago. The continuation of this policy should be encouraged and should prove highly beneficial to the organization.

THE CHAIRMAN:—As suggested by the secretary, we will be very glad, indeed, to receive suggestions from any of the members with regard to future entertainments in connection with our meetings. Personally, I have always thought that the club itself—that is, the proceedings of the clubs—should be a great incentive to railroad men not only to join but to attend. However, if we can increase our membership and also the attendance by little side lines such as we are having to-day, I am sure that we ought to have them and that they will be of great benefit to the club. Therefore, if any of the members have anything to suggest, if they will write to the secretary he will then hand it to the Executive Committee and the committee will be very glad to receive such suggestions. We are all very much obliged to Mr. Macbeth and the committee for the work they have done in connection with the entertainment this afternoon. I think a motion will be in order thanking the committee for its efforts.

THE SECRETARY:—Mr. President, I understand that the club is further indebted to Mr. George Lattimer for the use of a tug for the trip this afternoon and it seems to be very appropriate that somebody

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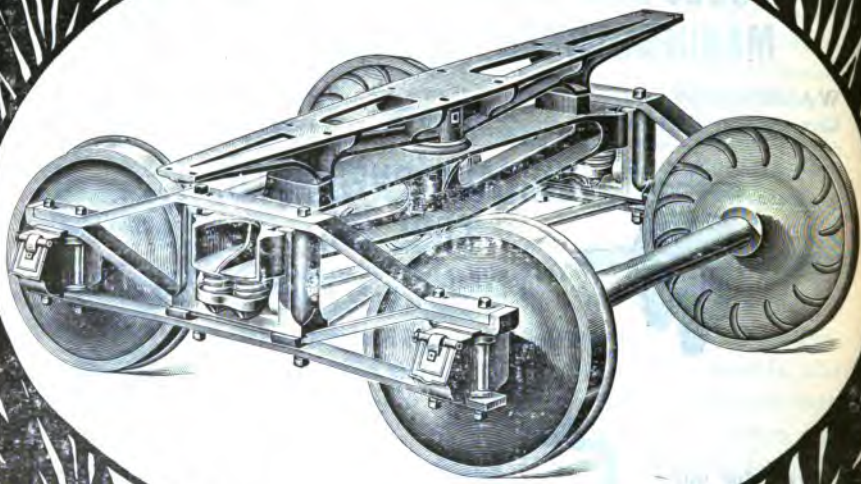

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should make a motion tendering the acknowledgments of the club for this courtesy. It is very generous.

THE CHAIRMAN:—I think it is.

MR. COREY:—I would move that the thanks of the club be tendered to the committee and that it be discharged with thanks.

Seconded and carried.

MR. MORFORD.—I move that the thanks of the club be tendered to Mr. Latimer who has so kindly placed a tug at the disposal of the club this afternoon to go to the Lackawanna Steel Plant.

Seconded and carried.

THE CHAIRMAN:—If there is no other business before the meeting, a motion to adjourn will be in order.

MR. O'DONNELL:—Mr. Chairman, before you adjourn, in line with the remarks of our worthy secretary, don't you think it would be wise to appoint a permanent Entertainment Committee for each year? This would do away with the inconvenience of writing the members at each meeting to ask whether they will accept the position. It seems to me it would be wise in connection with the secretary's remarks.

THE SECRETARY:—The Secretary will take occasion to say that while this committee has been discharged with respect to its present performance and at Niagara Falls, does it not appear to the members that so efficient a committee should be made permanent for the remainder of this year? There is only one more meeting, and, of course, they would have to arrange also for the January meeting; and when you've got a good thing hang on to it; push it along. (Laughter.)

MR. MACBETH:—Gentlemen, I think this is hardly fair. It is not alone for this year but it has been for years before. I think there are other gentlemen in Buffalo who ought to take hold of this. I am always glad to do what I can to entertain any one, even the Central Railway Club, but I do not think you ought to keep it going this way. It is quite an undertaking, sometimes.

MISCELLANEOUS BUSINESS.

THE CHAIRMAN:—I am sure we all appreciate Mr. Macbeth's efforts very much indeed, not only now but in the past, in connection with our club work. What is your pleasure, gentlemen?

MR. DOW:—I move Mr. Macbeth be appointed permanent chairman of the Entertainment Committee.

THE SECRETARY:—That is, to continue the entire committee the rest of the year?

THE CHAIRMAN:—Yes, with Mr. Macbeth as chairman.

Carried.

THE CHAIRMAN:—Any further business?

THE SECRETARY:—I think that is all, Mr. President,

MR. MACBETH:—I'll entertain you as long as there are any funds to do it with.

THE SECRETARY:—The Secretary is very glad to say in response to that, Mr. President, that we have over $1,500 in the bank to-day, so I don't think Mr. Macbeth need worry. (Applause.)

Adjourned.

THE NEXT MEETING.

The next regular meeting will be held at the Hotel Iroquois, Buffalo, N. Y., on Friday, November 13th, 1903.

Prof. W. F. M. Goss of Purdue University will read a paper, and a report will be made by a special committee on the Safety Appliance Law.

Other features will be scheduled as soon as arranged, and announced in the official call to be hereafter issued.

Harry D. Vought

Secretary.

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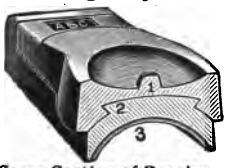

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August.—"Career for the Coming Men," treating of the opportunities offered for service in the passenger department, by George H. Daniels, General Passenger Agent New York Central.

WESTERN RAILWAY CLUB.

Sept. 15.—"Water Treatment in Railroad Operation," by G. R. Henderson; The Safety Appliance Law.

NEW YORK CLUB.

Sept. 18.—"The Proportions of Modern Locomotives," paper by Lawford H. Fry; "Effect of Cylinder Clearance upon the Quantity of Steam Consumed in Doing Specific Work, with Special Reference to Locomotive Practice," paper by Mr. Ira C. Hubbell.

RAILWAY CLUB OF PITTSBURG.

Sept. 25.—"The Nature of a Patent Right," paper by Paul Synnestredt.

NORTH-WEST CLUB.

Sept. 15.—"Wireless Telegraphy," a paper by D. McNicoll, telegraph department, Northern Pacific Railway; the Safety Appliance Law.

PACIFIC COAST CLUB.

September.—"A Study of Engine Frames; Deducing a Rational Method of Design"; paper by G. S. Edmonds, M. E., Delaware & Hudson R.R., Green Island, N. Y.

RICHMOND CLUB.

Sept. 10.—"The Export Grain Elevator Man and Some of His Troubles," by Mr. W. S. Upshur, Agent Chesapeake & Ohio Grain Elevator Co., Newport News, Va.

IOWA CLUB.

Sept. 15.—"Relations of the Press to the Railroads," by Al. Moore, Des Moines; "The Advantages of Acetyline Gas for Headlights," by G. Cook, Des Moines; "What is the Best Method to Insure the Better Inspection of Railroad Equipment," by J. Whalen, Des Moines.

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Central Railway Club

Vol. 9 November Meeting, 1903 No. 5

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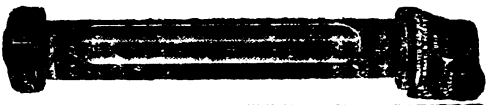

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OF THE

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VOL. 9. NO. 5. NEW YORK, November 13, 1903 $1.00 PER YEAR 25 CENTS A COPY.

REGULAR MEETINGS AT BUFFALO: SECOND FRIDAY IN JANUARY, MARCH, MAY, SEPTEMBER, AND NOVEMBER, AT 2 P. M.

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L. R. POMEROY, Spl. Rep., R. R. Dept. Gen. Electric Co., New York.

NEXT MEETING, Friday, January 8, 1904.

THE NOVEMBER MEETING

NIAGARA FALLS, N. Y.,
November 13, 1903.

The regular meeting of the Central Railway Club was held at the Natural Food Company's Hall, Niagara Falls, N. Y., Friday, Novem

ber 13, 1903, at 10 o'clock A. M., with President West in the chair. The members registered in attendance were:

H. M. Butts,
A. Bardsley,
J. A. Bradley,
Henry A. Boyd,
J. A. Barhydt,
Bloss P. Corey,
H. N. Demarest,
Harry Delaney,
S. R. Fuller, Jr.,
R. B. Foote, Jr.,
F. C. Ganson,
Arthur Gemunder,
Amos Gould,
E. M. Hedley,
W. H. Huck,
Elmer E. Harris,
William Hamilton,
George W. Jenings,
Edwin T. James,
E. Kopperman,
W. E. V. Kemp,
G. F. Knaus,
P. J. Langan,
R. S. Miller,
M. C. McCarthy,
J. D. Murray,
W. R. Mauerer,
John Mackenzie,
James A. Mellon,
Joseph Maycock,
James Macbeth,
L. C. Melsom,
David Meadows,
E. P. Mooney,
F. M. Nellis,
A. V. Newton,
William Ogilvie,
Thomas J. O'Donnell,
William Owens,
R. H. Parks,
H. H. Perkins,
Robert Potts,
L. R. Pomeroy,
T. Rhodes,
C. A. Sherman,
Thomas Sills,
W. O. Thompson,
A. F. Thayer,
Thomas Treleaven,
William Tunkey,
B. M. Tate,
C. E. Turner,
George L. Weiss,
George W. West,
F. W. Williams,
Calvin Youmans,

James B. Strong, of the Ramapo Iron Works, Niagara Falls, N. Y., was registered as a visitor.

THE PRESIDENT:—The first order of business is the reading of the minutes of the previous meeting.

THE SECRETARY:—The minutes have been printed and distributed to the members, Mr. President.

MR. POMEROY:—I move the minutes stand approved as printed in the proceedings. Carried.

THE PRESIDENT:—The next in order is roll-call. The Secretary advises me that the attendance cards will be distributed to the members. Next in order is remarks by the President. I can only congratulate you, gentlemen, on this beautiful morning and the fact that we have with us Prof. Goss and one of our past presidents (Mr. Mackenzie) and this goodly number in attendance. I will not delay you by any remarks but will pass to the regular order of business

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which is new members. The Secretary will now read the list of new members.

NEW MEMBERS.

The Secretary announced the names of the following new members:

Robert B. Foote, Jr., Manager Globe Oil and Supply Co., Buffalo, N. Y.

Charles S. Salisbury, Manager Merchants' Refrigerator Company, Buffalo.

C. P. Estis, Road Foreman of Engines, New York Central & Hudson River Railroad, Oswego.

A. H. Zenner, General Manager Zenner Disinfectant Company, Detroit, Mich.

D. W. Jackson, General Foreman Motive Power Department, Delaware, Lackawanna & Western Railroad, Elmira, N. Y.

H. T. Melvold, Storekeeper, Delaware, Lackawanna & Western Railroad, Buffalo.

DEATH OF W. H. JACKSON.

THE SECRETARY:—Mr. Jackson was enrolled as a member early in October, and a few days later Mr. Williams, who presented the application, wrote me that Mr. Jackson had met with an accident in which he received injuries from which he subsequently died. It seems proper, as Mr. Jackson had been duly enrolled, that the matter should be reported to this meeting. I have some memoranda from Mr. Williams in which he says:

"Mr. Jackson was struck by a locomotive about 12 o'clock noon of October 3rd. He was seriously injured and remained in an unconscious condition until 4.30 P. M., October 13th, when he died. He was an unmarried man, 27 years of age. He took a deep interest in his work and mechanical subjects in general and had a very promising future before him."

It seems proper that a committee should be appointed, Mr. President, to prepare a suitable memorial to Mr. Jackson.

MR. MOONEY:—I move a committee of three be appointed to draft suitable resolutions on the death of Mr. Jackson. Carried.

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THE SECRETARY :—The resignation of Mr. E. D. Nelson has been received. In a letter of withdrawal he says: "I am afraid I shall be unable to take any part in the matters coming before the Central Railway Club and although I have not attended the meetings as much as I should have liked, I feel now it will be impossible to get to Buffalo, and therefore beg now to present my resignation to the club."

THE PRESIDENT :—The next in order is the report of committees.

THE QUESTION-BOX.

THE SECRETARY :—In behalf of the executive committee, Mr. President, it is necessary to report that after the adjournment of our last meeting the President appointed committees as follows on the questions which had been deposited in the Question-Box :

"What is the best method to induce apprentices to go and stay in the boilermaker and blacksmith shops?" Mr. W. O. Thompson.

"Why, when steam heat gauge on engine shows 75 or 80 pounds pressure, in many cases gauges in cars, in train will not show anything?" Mr. C. M. Hogan.

"What is the amount of water necessary to haul 100,000 tons of freight 100 miles?" Mr. William Owens.

THE ENTERTAINMENT COMMITTEE.

The program submitted by the committee on entertainment you have probably all received and no change has been made. There is a report due to-day on the safety appliance law from a committee to whom it was referred at the last meeting. That committee consists of F. W. Williams, of the Lackawanna, chairman; John Howard of the New York Central and William Tunkey of the Lake Shore. After our last meeting postal cards were sent out asking members to make recommendations to the committee on entertainment as to what they thought would be best for this and future meetings. The following letter was sent to the Secretary in response to one of the cards :

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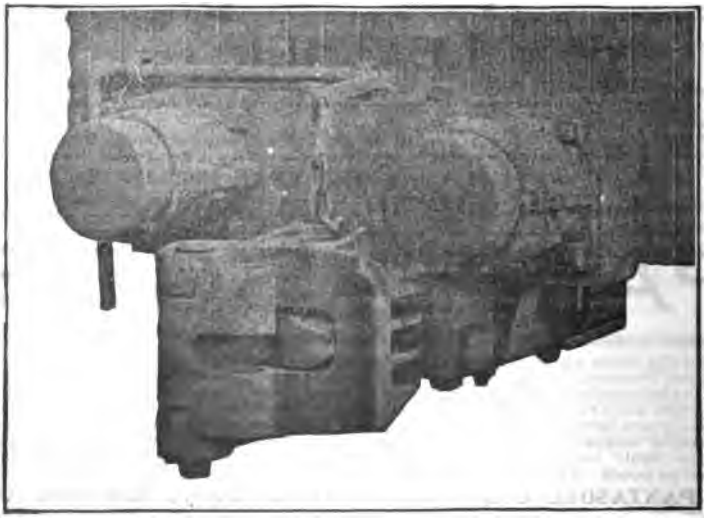

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BUFFALO, Sept. 28, 1903.

Mr. Harry D. Vought, Sec'y Central Railway Club, New York.

DEAR SIR:—Referring to the inquiry made in your circular postal card of the 23rd inst., I have no suggestion to make that I think would be of any value to the entertainment committee. That committee is certainly a very competent one and they are really in better position than any one to determine what would be most agreeable to the membership of the club at large. It seems to me they have been quite successful in the past in whatever they have done.

Sincerely,

O. P. LETCHWORTH.

PNEUMATIC TOOLS ON RAILROADS.

With reference to a special paper to-day on "Pneumatic Tools and Their Application to Railroads," it was not possible to close the engagement for this meeting. A number of gentlemen connected with the Chicago Pneumatic Tool Co., who wished to be present when the paper was read, are at Chattanooga at this time attending another convention and the matter is held until our January meeting at which time we will also have a paper from Prof. Magruder of the Ohio University. His subject will be "Gas and Gasolene Engines in Railway Work."

This is about all at this time that would naturally come from the executive committee. The next in order is a paper by Prof. Goss of Purdue University.

THE PRESIDENT:—I think it is nearly two years since Prof. Goss honored us before and I have great pleasure in presenting to you to-day Prof. Goss. (Applause).

PROF. GOSS:—Mr. President and gentlemen, I assure you that it gives me great pleasure to be with you to-day. I have good reasons for concluding that this is the most wide awake railway club in the country. I have been down in New York where their railway club meets at eight o'clock in the evening, and out in St. Louis, where they meet at the fashionable hour of six, and in Chicago two o'clock is the hour, but here I find a railway club which begins its work the first thing in the morning.

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RECENT PROGRESS IN THE DESIGN OF LOCOMOTIVE FRONT-ENDS.

The term "front-end" refers to all that portion of a locomotive boiler which is beyond the front tube-sheet. It includes the extending shell of the boiler which forms the smoke-box, and in general all mechanism which is therein contained such as steam and exhaust pipes, nettings, diaphragms, draft pipes. It also includes the stack.

The front-end as thus defined is to be regarded as an apparatus for doing work, receiving energy from a source of power, and delivering a portion thereof in the form of a specific result. The source of power is the exhaust steam from the cylinders, and the useful work accomplished is represented by the volumes of furnace gases which are delivered against the difference of pressure existing between the smoke-box and the atmosphere. That the power of the jet may be sufficient, it is necessary that the engines of the locomotive exhaust against back-pressure. The presence of the back-pressure tends to lower the cylinder performance, and it is for this reason that designers of front-ends have sought to secure the required draft action in return for the least possible back-pressure. In other words, the effort has been to increase the ratio of draft to back-pressure, which ratio has been defined as the efficiency of the front-end.

During the seventy-five years which have passed since Stephenson in the construction of the "Rocket" first turned the exhaust from the cylinder into the stack, no other detail of the locomotive has been subjected to such persistent experimentation as the front-end. Unfortunately, the investigations have in most cases dealt with apparatus that was highly specialized, or have been influenced by conditions which do not now prevail, and it is only recently that efforts have been made to secure fundamental data upon a plan sufficiently broad to be of permanent service. During the last few years, however, much good work has been done. It is the purpose of this paper to pass in review those facts concerning the design of the front-end, which have been derived from recent investigations, and which give promise of greatest usefulness.

Distribution of Draft.*

The office of the front-end is to draw atmospheric air into the ash-pan thence through the gate and fire; to draw the furnace gases through the tubes of the boiler, thence under the diaphragm and into the stack, and to force them out into the atmosphere. In order that this movement may take place, a pressure less than that of the atmosphere is maintained in the smoke-box so that when the locomotive is working, there is a constant flow from the

*Locomotive Draft Appliances, American Engineer, May, 1902.

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atmosphere along the course named and back to the atmosphere again. The difference in pressure between the atmosphere and the smoke-box is spoken of as the draft and, under normal conditions of running, is usually represented by from 4″ to 6″ of water. The draft thus expressed, however, is greater than that to which the fire is actually subjected. Thus: approximately, a third of the total draft is required to overcome the resistance of the ash-pan and grate together with the fire thereon. Another third is required to overcome the resistance of the tubes, and another third to overcome the resistance of the diaphragm. For example, if the total draft is observed to be 6″, it will be found that the draft in the fire-box is approximately 2″, at the front end of the tubes approximately 4″, and in the forward portion of the smoke-box 6″. These facts serve to explain several things which ordinarily are not well understood. The fact that the diaphragm absorbs as much of the energy of the exhaust jet as the grate and all the fire thereon, should have in it a suggestion for those who are endeavoring to improve the locomotive front-end. If the diaphragm could be abandoned, or if the area under it could be materially increased without introducing new difficulties, the efficiency of the front-end could be greatly improved.

The question has often been asked how it is that ordinarily a wide fire-box engine will not run with a larger exhaust nozzle than the narrow box engine. The assumption behind this question is that since the grate is large, the draft necessary to stimulate the combustion is reduced, and hence the work which the steam jet has to do is diminished. The preceding statements give a response to such questions. Whether the grate be large or small, two-thirds of the difference in pressure between the front-end and the atmosphere is absorbed in moving the air and gases through the tubes and under the diaphragm. The volume of air and gases to be moved is not materially changed by changing the area of the grate, and while the difference in pressure between the atmosphere and the fire-box will be less with the large grate than with the small one, this difference is insignificant in amount when compared with the total draft action which is required to stimulate the movement through the remaining portion of the systems.

The Action of the Exhaust Jet.*

Prior to the publication of the Master Mechanics' Proceedings

*The American Railway Master Mechanics' Association as early as 1890 had appointed a committee to report on the best forms of exhaust nozzles and steam passages which committee, after making one report, and after being continued for several years, finally gave way to a new committee under the chairmanship of Mr. Robert Quayle, with the result that in 1896, an epoch making report was presented. The work of this committee settled two important questions, namely, the action of the exhaust jet, and the form for exhaust pipes and nozzles. The facts presented in this paragraph are largely drawn from this report.

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for 1896, it had been common to assume that the action of the exhaust-jet was similar to that of a pump, that the exhaust from each cylinder-end supplies a ball of steam which fills the stack very much as the piston of a pump fills its cylinder, and which, by virtue of its own momentum, pushes before it a certain volume of the smoke-box gases until it passes out of the top of the stack. In obedience to this theory, earlier experimenters had given much attention to a determination of the angle made by the jet of exhaust steam, to the end that the stack might be so proportioned that the diameter of the jet would agree with that of the stack at the point of initial contact. This theory is no longer acceptable. It has now been shown by means of delicate apparatus, which need not be here described, that the form of the exhaust-jet is similar to that set forth by Fig. 1, from which it appears that the jet of steam does not fill the stack at or near the bottom, and that under certain conditions common to practice, it touches the stack only when it is very near the top. An attempt to contract the stack at its base to make it meet the vein of steam results in a further contraction in the steam vein. Gauges connected with the stack at intervals along its length show that the reduced pressure of the smoke-box extends upward into the stack to points approaching the top, the pressure within the base of the stack being actually less than that of the front-end. All this goes to show that the vein of steam which energizes the action of the front-end is enveloped by a zone of smoke-box gases which are drawn on by it, the direction of motion of these gases toward the steam jet being suggested by the arrows in Fig. 1. All this is conclusive evidence that the action of the jet is not that of a pump, as has been previously supposed, but rather one of induction; the exhaust-jet does not push the gas before it, but draws them to itself and thence into the atmosphere. Such a conclusion is confirmed, also, by experiments made upon a locomotive at rest, having its valves blocked away from the seat, and the pressure in the exhaust pipe controlled by the throttle, all in such a manner as to give a steady blow of steam from the exhaust pipe instead of the usual succession of puffs. The jet thus formed has been found to have the same form and to be as efficacious in producing draft as a jet which results from the discharge of a similar weight of steam from the same pressure in the exhaust pipe, in the form of exhaust resulting from the running of the engine.

But the action is not entirely that of induction. A study of the exhaust-jet shows that different portions of the jet have different velocities, and that particles having the same velocity do not move either in straight nor uniformly curved lines, the facts with reference

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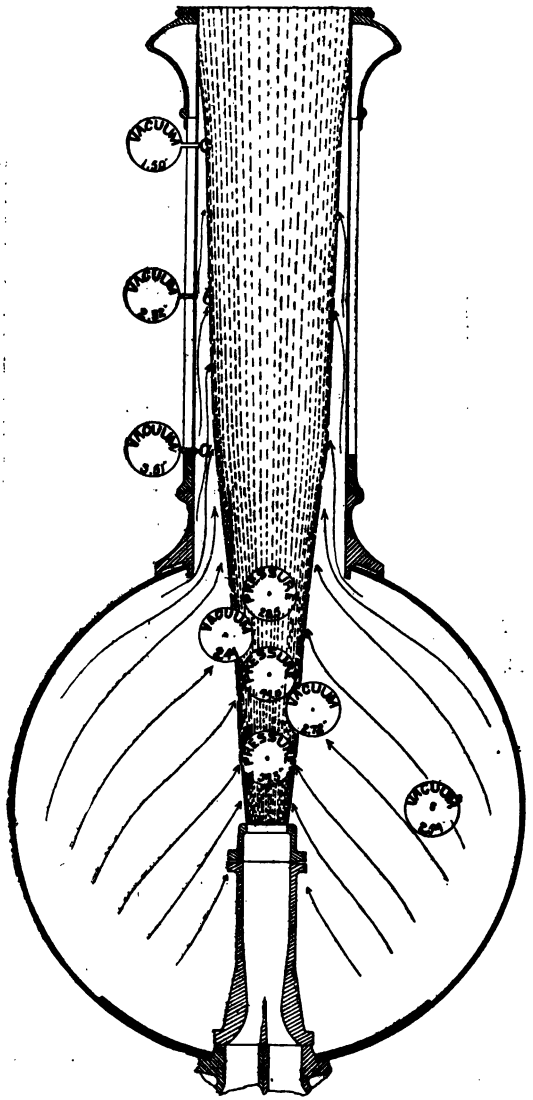

B the pressure and vacuum are in inches of water.

Fig. 1.

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to this matter for a typical case being those shown by Fig. 2. The heavy lines laid down upon the jet in this figure indicate the path of particles having equal velocity. The numbers at the left of the jet give the value of the velocity in feet per second for each line. The diagram serves to show that the interior portions of the jet have a much higher velocity than the exterior portions which, it may be

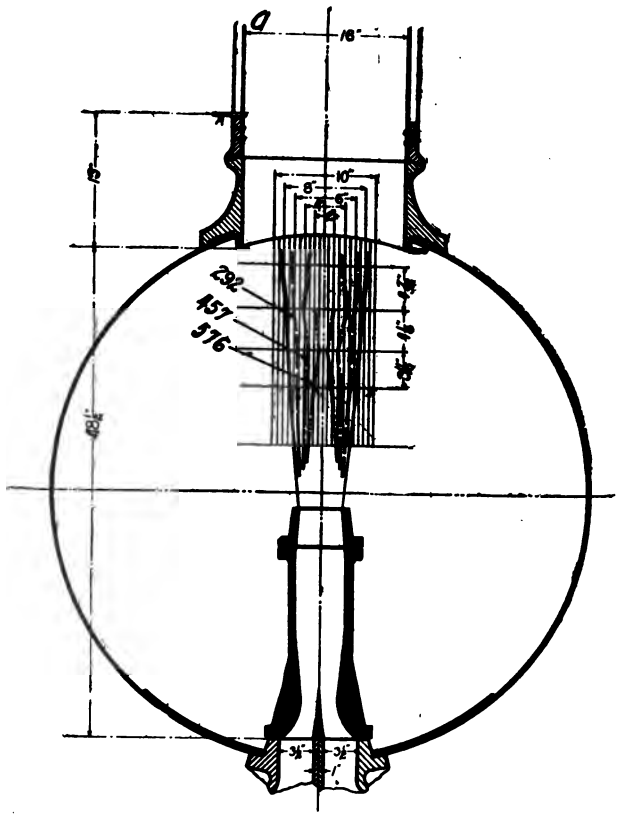

Fig. 2.

presumed, are retarded through their contact with the smoke-box gases to which a portion of their initial energy has been imparted.

The result of the different velocities in the same stream is a wave motion within the stream as a whole. The jet is in fact stepped off

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into nodes which, under given conditions, remain fixed in position. Thus, the lines of uniform velocity of Fig. 2, which have been determined by experiment, become when but slightly

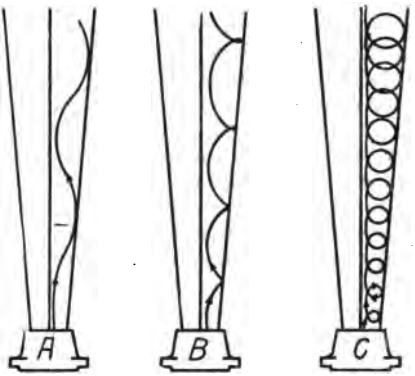

Fig. 3.

modified, the line shown by A, Fig. 3. Its exact form will depend upon the differences in the velocity of particles in different portions of the stream, and the actual mean velocity of the jet. If the velocity of the jet is high, and the retarding influence of the surrounding gases strong, the wave lengths may be shorter as shown by Fig. 1, B, and with still greater difference between the inside and outside of the jet, the loops approach the form shown by Fig. 1, C. These are general propositions with reference to the wave action in streams. The actual exhaust jet appears to have a wave of considerable length similar to that of A, Fig. 3, but the fact should be recognized that it contains all the elements possessed by shorter wave lengths, such as C, Fig. 3. Having shown the existence of a wave action, it is not difficult to prove a mixing or enfolding action by means of which the steam takes up and carries forward as a part of the jet itself considerable quantities of the surrounding action. Thus, if the waves are short as in C, Fig. 3, such an action becomes plain, and the lengthening out of the wave can not entirely eliminate it. The induced action is greatest at the exhaust tip and diminishes as the jet proceeds toward the top of the stack, while the intermixing is least at the exhaust tip and increases as the jet proceeds. The maximum effect of the intermixing is to be found at the top of the

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stack, but even at this point the mixture is never perfect.* Thus, the center of the issuing stream is composed chiefly of steam while its outer portions are heavily loaded with the smoke-box gases. The sparks and cinders are principally discharged from the outer portions of the stream.

The power of the exhaust jet, other things being the same, is not dependent upon any condition of running. It does not change when the speed and cut-off are changed. It depends chiefly upon the rate at which steam is delivered from the exhaust tip. If the weight of steam exhausted per unit of time is unchanged, the locomotive may be at rest with its valves blocked up, it may be worked at a slow speed and long cut-off, or at a high speed and short cut-off, and in each case the draft will be the same. On the other hand, any change in the weight of steam exhausted, affects the draft and herein is evidence of the excellent condition of balance which exists in a locomotive between the rate of evaporation and the condition of the fire which produces it. Whenever, by any change in running, there is an increase in the weight of steam exhausted, the draft is strengthened, the rate of combustion augmented, and the evaporation of the boiler is increased.

Summarizing the foregoing statements, the facts which are now well established concerning the action of the exhaust jet may be stated as follows:

1.—The jet acts upon the smoke-box gases in two ways; first, by frictional contact, it induces motion in them, and, second, it enfolds and entrains them.

2.—The action of the jet upon the smoke-box gases is to draw them to itself so that the flow within the front-end is everywhere toward the jet.

3.—The action of the jet is not dependent upon the impulses resulting from individual exhausts. Draft can be as well produced by a steady flow of steam as by the intermittent action of the exhaust.

4.—Draft resulting from the action of the jet is nearly proportional to the weight of steam exhausted per unit of time. It does not depend upon the speed of the engine nor the cut-off of steam from the cylinders, except in so far as these affect the weight of steam exhausted.

5.—The form of the jet is influenced by the dimensions of the channels through which it is made to pass. Under ordinary conditions, it does not fill the stack until near its top. If the diameter of the stack is changed, that of the jet will also change.

*See a paper, "The Effect of High Rates of Combustion Upon the Efficiency of Locomotive Boilers," New York Railway Club, Sept., 1898.

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Form of the Exhaust Nozzle.

Two general forms of exhaust pipe and nozzle have for many years been in common use, one a "double pipe and nozzle," in which the exhaust steam from each cylinder follows a separate passage throughout its course to the point where it is delivered, and the other, a single exhaust pipe and nozzle in which the exhaust steam from both cylinders is brought together to form a single jet before delivery. The double exhaust pipe might, so far as its function is concerned, be made up of two separate castings, but for convenience the parts are combined, as shown by Fig. 4. A typical single exhaust pipe is shown by Fig. 5.

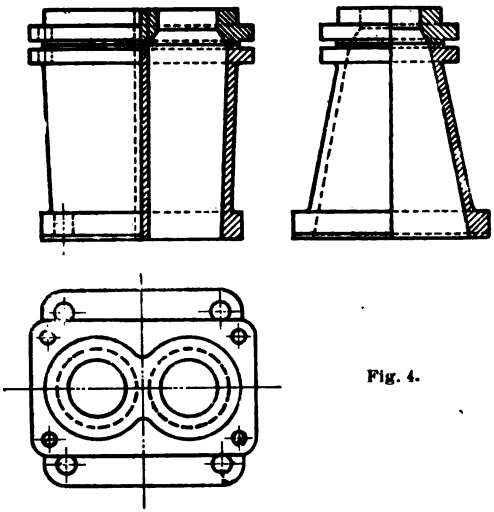

Fig. 4.

Many other forms of exhaust pipes had been used, and are still in service, but the probability is that none possessed exceptional advantages as compared with the two forms mentioned. As one of the conclusions of their long and laborious investigation of 1896, the Master Mechanics' Committee found but little difference in the efficiency of the single and double nozzle when each is properly proportioned to its work, though incidental reasons seem to favor the single nozzle. The committee therefore concurred in the recommendation of the previous committee in recommending that the single nozzle be adopted for general use.

Height of Exhaust-Pipe and Tip.*

It has been shown beyond question that the lower the exhaust tip,

* Report on Exhaust Ports and Steam Passages, Proceedings A. R. M. M. A., 1896. Also, Locomotive Draft Appliances, American Engineer, December, 1902, and May, 1903

the better will be the draft. From data obtained in the tests of the American Engineer, it should be possible to derive an expression, showing the change in draft power resulting from given changes in the height of the nozzle, but thus far such an expression has not been proposed. It may be said, however, that the gain in draft power which may be had by lowering the nozzle even a few inches is sufficient to justify some sacrifice of convenience if the arrangement of other details demand it. The Master Mechanics' Committee of 1896 expressed the belief that in view of the other apparatus to be accommodated in the front-end, it will be found impracticable to have the exhaust-pipe less than 19" in height.

Height of Bridge in Pipe.*

An essential feature of the single exhaust pipe is the so-callled bridge (Fig. 5) which maintains a separate steam passage for each

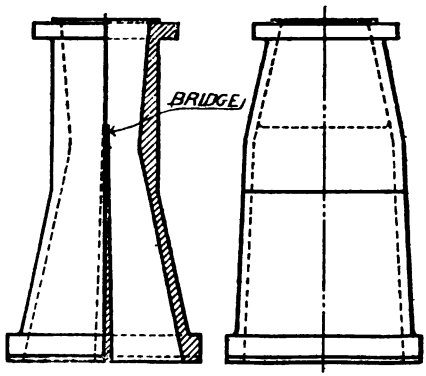

Fig. 5.

cylinder for a portion of the length of the pipe. It is above the top of this bridge only that the steam exhausted from both sides of the locomotive intermingles. The purpose of the bridge is a two-fold one. It prevents the exhaust of one side from blowing through into the exhaust passage of the other side, and when properly designed it is the means of making that side from which the strongest stream is passing assist by induction the exhaust from the other side. To determine the best height of the bridge, exhaust pipes of four different designs were tested by the Master

* Report on Exhaust Ports and Steam Passages, Proceedings A. R. M. M. A., 1896.

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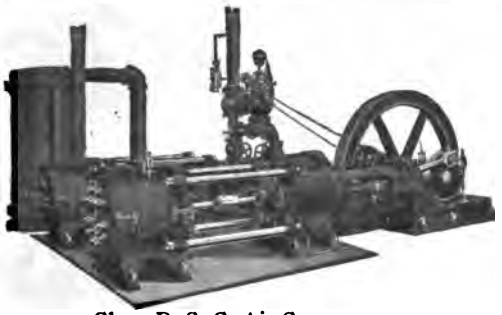

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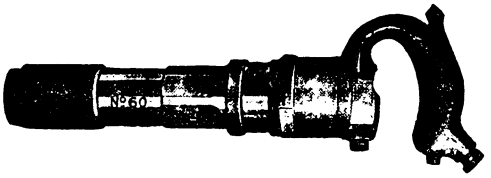

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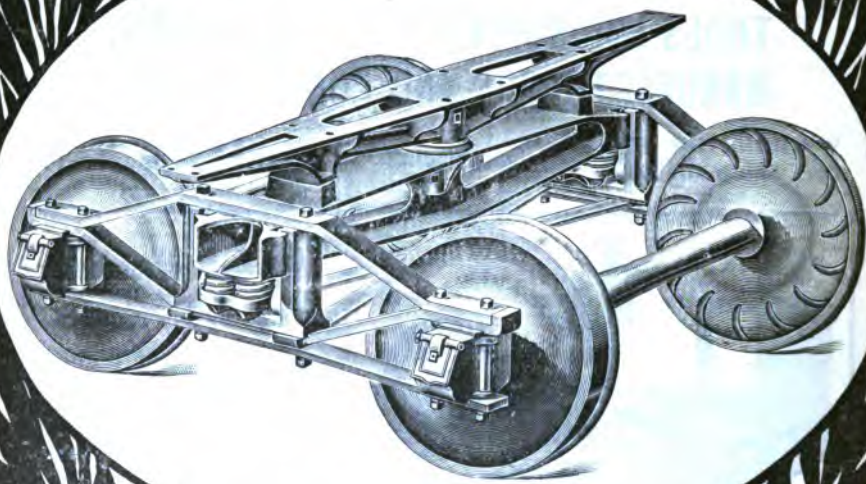

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Mechanics' Committee, all being the same except in the height of the bridge and in the proportions of those parts adjacent thereto. Fig. 5 is the design having the highest bridge and Fig. 6 the design having

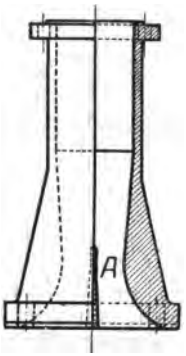

Fig. 6.

the lowest bridge. The conclusion of the committee was that whenever the bridge was less than 12", some loss of efficiency resulted, though such loss was not great even when the height of the bridge was reduced to 5". They recommend that the bridge be not less than 12". They recommend, also, that where long exhaust pipes must be employed, that the increased length should always be secured by extending that portion of the pipe which is above the bridge. This recommendation in effect conetmplates a constant height of bridge for all lengths of pipes.

Area of Choke.*

That part of the steam pipe between the bridge and the outside wall where the contraction of the passage is greatest, A, Fig. 6, has generally been referred to as the "choke." An early committee had recommended that the area of the choke be 80 per cent. of that of the nozzle, and the committee of 1896 did a large amount of work upon pipes having this proportion. Not satisfied, however, with the validity of the conclusions, the later committee extended its research to involve a large range of proportions, with results sustaining the conclusions: First, that the area of the choke must not be less than the area of the nozzle, and, second, that whenever with a given pipe, it is necessary to sharpen the exhaust action, the result should be secured by contracting the nozzle, and not by contracting the choke.

*Report on Exhaust Ports and Steam Passages, Proceedings A. R. M. M. A., 1896.

Form of Nozzle.

Three forms of nozzle were experimented upon which may be designated as x, y and z, Fig. 7, with results so nearly identical that

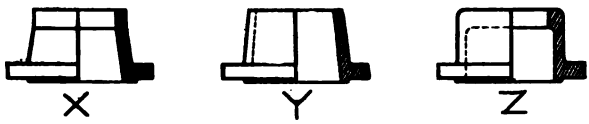

Fig. 7.

the committee was unable to present convincing proof in favor of either one of them, though it recommends that the form x be used. The recommendation is based on the fact that this form spreads the jet less than the others shown, it having been shown in the study of the action of the jet, that highest efficiency is had when the spread of the jet is least.

Use of Bars or Crosses Over the Nozzle.

It is well known that engines which refuse to steam may sometimes be made to do so by bridging the exhaust nozzle with a small piece of round iron or by a bar or bars having a knife-edged cross-section designed to spread the jet and at the same time impede its motion as little as possible. Experiments were therefore made by the committee of 1896 both upon round bars and upon crosses, shown by Fig. 8, with results

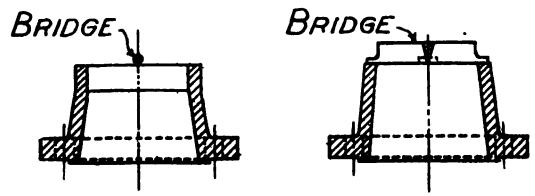

Fig. 8.

confirming previous experience upon the road. It was found that by spreading the jet by means of such devices, the draft could be improved, but in all cases, the presence of the bridge so much increased the back pressure that the efficiency of the front-end was reduced. In other words, the presence of the bar or cross produced the same effect upon the back pressure as the substitution of a smaller nozzle without the bars. They found that cross bars (Fig. 8) not

*Report on Exhaust Ports and Steam Passages, Proceedings A. R. M. M. A., 1896.

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wider than $\frac{3}{8}$ of an inch, and having the lower portion shaped to a sharp knife edge, placed on the nozzle or any distance not greater than one inch above it, increased the back pressure, and that crosses having wider bars increased the back pressure at a greater distance from the nozzle. In view of these facts, and, also, in view of the fact that all evidence goes to show that for highest efficiency the jet should be kept as well compacted as possible, the practice of splitting it up is not to be commended. It is better practice in cases where the draft is unsatisfactory to reduce the diameter of the exhaust nozzle than to attempt to secure the desired result by employing a larger nozzle with a bridge above it.

THE STACK PROBLEM.

A review of published accounts of experiments upon draft appliances under service conditions indicates that until recently but slight attention has been given the stack. This is not due to any lack of appreciation of its importance, but rather to the difficulties which are to be met in attempts to find a logical basis for its design. A measure of uncertainty which has in the past prevailed is indicated by the fact that many roads have had large and small engines running with stacks of the same diameter.

A few years ago there were undertaken at Hanover, Germany, an elaborate series of tests designed to solve the stack problem. The results, which in this country have been known as those of the von Borries-Troske tests,* have been widely published. They were conducted upon a full sized model front-end, steam being supplied from a stationary boiler, and air in imitation of the smoke-box gas being admitted to the front-end through a restricted opening. While they have undoubtedly served well to guide the practice of German railways, they have not greatly influenced that of our own country. When, therefore, the American Engineer and Railway Journal offered to act as patron for a series of stack tests, to be run upon the experimental locomotive of Purdue University, and when the Trustees of Purdue University met this offer by contributing the use of its equipment, and the time of its expert staff, a field of research which previously had been quite neglected, was entered upon. In the course of these tests, straight stacks and tapered stacks were used, each form being represented by four different diameters and five different heights, so that in effect there were twenty different straight stacks and twenty different tapered stacks employed. Each of these stacks were tested in connection with seven different heights of nozzle and for many of them results were repeated under different conditions of speed and for different conditions of cut-off so that

*An excellent review of these tests is given in the American Engineer, November and December, 1901, by Mr. H. H. Vaughan.

altogether something more than a thousand distinct tests were made. The more important results are summarized in the paragraphs which follow.

Form of Stack.*

An equal degree of efficiency can be secured by means of either the straight or tapered form of stack. As a problem in design, the tapered stack is the more simple, since its diameter for best results is not affected by changes in height. The straight stack, on the other hand, must have a different diameter for each different height. Moreover, it appears that a departure from correct proportions in the case of the tapered stack is less harmful in its effect upon draft than in the case of the straight stack. For these reasons the tapered is to be preferred, and that which follows will chiefly concern this form. For the purpose of this presentation the tapered stack must be understood as one having its smallest diameter at a distance 17½" from the base, above which point its diameter increases at the rate of 2" per foot, these being the proportions of the experimental stacks by the use of which the following conclusions were reached. It should be noted, also, that the relations stated in the paragraphs which follow, with reference to stacks, are those which are known to apply to front-ends 54" in diameter. It is assumed that by employing the diameter of front-end as a unit of measure, they may be made to apply to any diameter of front-end. The assumption is a logical one but its validity has not yet been absolutely proven.

Proportions of a Tapered Stack.*

The height is an important factor in a stack, and in general, the greater the height of stack the better will be the draft. So far as present information indicates, there seems to be no substitute for height; that is, there is no change in the proportion of the stack itself and no change in the relation of stack and nozzle which will compensate for loss of height. It remains, therefore, to always make the stack as long as possible, and, having done this, to design the surrounding parts for maximum efficiency. For best results, a tapered stack at its point of greatest contraction should have a diameter equal to one-fourth the diameter of the front-end. This is true whether the stack is long or short. Assuming that the results obtained from a single experimental engine are sufficient to justify a general equation for the diameter of stack,

$$d = .25\ D$$

in which d is the diameter of tapered stack at the point of greatest

*Front-End Appliances, American Engineer, April and May, 1903.

contraction when the exhaust tip is on the center line of the boiler, and D is the diameter of the front-end of the boiler. The diameter of stack is affected slightly by changes in the height of the nozzle. It should be diminished as the nozzle is raised and increased as the nozzle is lowered. Calling h the distance in inches between the center line of boiler and the exhaust nozzle, the extent of the change which must thus be introduced may be expressed as follows:

When the nozzle is below the center of the boiler,

$$d = .25\ D + .16\ h$$

When the nozzle is above the center line of the boiler,

$$d = .25\ D - .16\ h$$

When the nozzle is on the center line of the boiler, h becomes zero, the term containing it disappears, and the equation becomes,

$$d = .25\ D$$

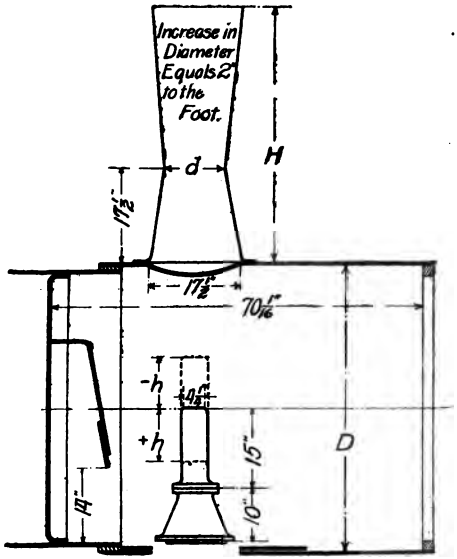


Fig. 9.

A diagram of the front-end, indicating conditions under which these equations apply is shown by Fig. 9, and a tabulated statement of stack diameters applying to front-ends of various diameters, and of various heights, is given as Table I.

TABLE I.

TAPER STACKS.

Diameter at Choke of Stack for any Height when Stack Tapers 2 Inches to the Foot.

Front End of Boiler; Diameter in Inches.	Distance Between Center Line of Boiler and Top of Exhaust Tip. Inches.									
	Tip Below Center.				Tip on Center.	Tip Above Center.				
	20	15	10	5		5	10	15	20	25
30	....	....	9.1	8.3	7.5	6.7	5.9	....	....	....
32	....	....	9.6	8.8	8.0	7.2	6.4	....	....	....
34	....	10.9	10.1	9.3	8.5	7.7	6.9	....	....	....
36	....	11.4	10.6	9.8	9.0	8.2	7.4	....	....	....
38	12.7	11.9	11.1	10.3	9.5	8.7	7.9	7.1	....	....
40	13.2	12.4	11.6	10.8	10.0	9.2	8.4	7.6	....	....
42	13.7	12.9	12.1	11.3	10.5	9.7	8.9	8.1	....	....
44	14.2	13.4	12.6	11.8	11.0	10.2	9.4	8.6	....	....
46	14.7	13.9	13.1	12.3	11.5	10.7	9.9	9.1	8.3	....
48	15.2	14.4	13.6	12.8	12.0	11.2	10.4	9.6	8.8	....
50	15.7	14.9	14.1	13.3	12.5	11.7	10.9	10.1	9 3	....
52	16.2	15.4	14.6	13.8	13.0	12.2	11.4	10.6	9.8	....
54	16.7	15.9	15.1	14.3	13.5	12.7	11.9	11.1	10.3	9.5
56	17.2	16.4	15.6	14.8	14.0	13.2	12.4	11.6	10.8	10.0
58	17.7	16.9	16.1	15.3	14.5	13.7	12.9	12.1	11.3	10.5
60	18.2	17.4	16.6	15.8	15.0	14.2	13.4	12.6	11.8	11.0
62	18.7	17.9	17.1	16.3	15.5	14.7	13.9	13.1	12.3	11.5
64	19.2	18.4	17.6	16.8	16.0	15.2	14.4	13.6	12.8	12.0
66	19.7	18.9	18.1	17.3	16.5	15.7	14.9	14.1	13.3	12.5
68	20.2	19.4	18.6	17.8	17.0	16.2	15.4	14.6	13.8	13.0
70	20.7	19.9	19.1	18.3	17.5	16.7	15.9	15.1	14.3	13.5
72	21.2	20.4	19.6	18.8	18.0	17.2	16.4	15.6	14.8	14.0
74	21.7	20.9	20.1	19.3	18.5	17.7	16.9	16.1	15.3	14.5
76	22.2	21.4	20.6	19.8	19.0	18.2	17.4	16.6	15.8	15.0
78	22.7	21.9	21.1	20.3	19.5	18.7	17.9	17.1	16.3	15.5
80	23.2	22.4	21.6	20.8	20.0	19.2	18.4	17.6	16.8	16.0
82	23.7	22.9	22.1	21.3	20.5	19.7	18.9	18.1	17.3	16.5
84	24.2	23.4	22.6	21.8	21.0	20.2	19.4	18.6	17.8	17.0
86	24.7	23.9	23.1	22.3	21.5	20.7	19.9	19.1	18.3	17.5
88	25.2	24.4	23.6	22.8	22.0	21.2	20.4	19.6	18.8	18.0
90	25.7	24.9	24.1	23.3	22.5	21.7	20.9	20.1	19.3	18.5

THE STRAIGHT STACK.*

As stacks of this form are not especially recommended, no detailed discussion need be given. Equations applying to a straight form of stack may, however, be written as follows:

*Locomotive Front-Ends. American Engineer, May, 1903.

When the exhaust nozzle is on the center line, h is equal to zero and the last term disappears and there remains,

$$d = (.246 + .00123\ H)\ D$$

When the exhaust nozzle is below the center line of the boiler,

$$d = (.246 + .00123\ H)\ D + .19\ h$$

When the exhaust nozzle is above the center line of the boiler,

$$d = (.246 + .00123\ H)\ D - .19\ h$$

In these equations, d is the diameter of stack, H the height of stack, D the diameter of the front-end, and h the distance between the center line of boiler and the exhaust nozzle. All dimensions in

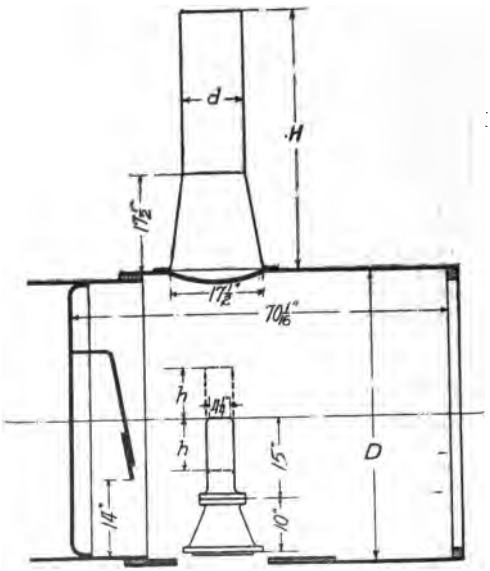


Fig. 10.

inches. Fig. 10 indicates more clearly the conditions under which the equations are assumed to apply.

In conclusion, it will be seen that investigations already made have served to make clear the action of the exhaust jet, and the condition of pressure which stimulates the currents of air and furnace gases throughout the course from the ash pan to the top of the stack. Existing data is sufficient, also, to guide in the design of the exhaust-pipe and tip for maximum results. All this is to be accepted as a certainty. In addition, the probability is that we may design stacks

for maximum efficiency though the statement must be subject to some qualification until the experiments already made at Purdue have been checked by trials involving larger engines either upon the road or testing plant. This settled, there remains of those elements which characterize the modern front-end, the problem of the draft-pipe, of the inside stack, by which is meant a stack extending downward into the front-end and terminating in a bell-shaped end, and of the inside stack in connection with a false top within the smoke-box. All of these questions are now under consideration by a committee of the Master Mechanics' Association, under the chairmanship of Mr. H. H. Vaughan, whose interest in the subject makes it not unreasonable to expect that within the next two years, all portions of the front-end may be correctly designed by aid of logical formulæ.

THE PRESIDENT:—The subject is now open, gentlemen, and I hope there will be a full discussion.

MR. POMEROY:—The finished and beautiful work carried on by Prof. Goss, in connection with the laboratory locomotive at Purdue University, is familiar to us all. This work has been so specific and definite, especially in the realm of locomotive draft appliances, that for a layman to attempt the discussion of a paper which is the outgrowth of all of this experience and special investigation is like attempting to "gild refined gold" or "paint the lily" or "to add another hue unto the rainbow."

It is therefore with no thought of discussing the paper that I arise to my feet, but in the hope of getting information and perhaps suggest to others a line of discussion.

We all know that it is unreasonable to expect to reach satisfactory results from road tests, especially where the results to be sought are due to slight modification in details, and where the differences, if any, are, from the nature of the case, slight. Oftentimes the personal equation, that is, the men handling the locomotive, the variation in load behind the tender, atmospheric and other variables, more than account for differences in results (?) obtained. Consequently, where such fine distinctions are required, a test made with a laboratory locomotive, where the variables are under control or where the conditions can be duplicated, is the only satisfactory way of producing results that are comparable with each other.

Exploration in the realm of locomotive draft apparatus falls

under the foregoing conditions and we are greatly indebted to Prof. Goss for making such microscopic investigation possible.

With reference to what is said on page 8 concerning single and double nozzles, I note the statement that little or no difference was found between single and double nozzles, but that the committee were inclined to favor the single nozzle. My own preferences have always been for the single nozzle, but for the life of me I never could give an intelligent reason for this preference. I hope, therefore, that Prof. Goss can throw some light on the subject, as to why this preference was given by the committee.

Another point is that all the data given is predicated on a vacuum in the smoke-box. I have never been able to reconcile this point with the fact that the London and Northwestern, Webb Compound, imported by the Pennsylvania Railroad some years ago, had an opening into the smoke-box as large as your hat.

It is a great comfort to have the definite statement, on page 12, that "the results obtained confirmed statements previously made from the Purdue Laboratory to the effect that the efficiency of the front end is not dependent upon the speed, cut-off or other conditions of running." And the further fact, page 13, that "straight and tapered stacks were of equal efficiency; that the tapered stack is more simple because the diameter is not affected by the height, while on the other hand, with straight stacks, the diameter must be different for each variation in height.

The paper under discussion, and in fact all the literature bearing on locomotive front-end arrangement, seems to more directly apply to soft coal burning engines. Some of us, who are in touch with the anthracite burning problem, would like information concerning the best type of front-end arrangement for hard coal burning engines. The question involves more than the mere vacuum in the smoke-box, but what we would like to know is what type of arrangement of the front end, exhaust pipe, nozzle, etc., is best suited to hard coal conditions.

If not out of place, in this connection, I would like to ascertain to what limitations and conditions the former Master Mechanics' Association were confined in their investigations of locomotive draft appliances, and the scope of the tests and investigations now being

conducted on behalf of the American Engineer in conjunction with the Master Mechanics' Association.

Prof. Goss referred to the disappointment in some quarters owing to the inability to enlarge the exhaust tip on the wide fire-box type of engines. I am rather surprised to hear of such an expectancy, for I cannot see why the increase in grate area should affect the front-end arrangement, for I always supposed the benefits to be derived from the wide fire-box boiler, was the ability to utilize a lower rate of combustion, and the possibility of using a lower grade of fuel.

Some time ago the statement was made that on certain fast trains on the Chicago, Burlington & Quincy and Chicago & Northwestern, handled by engines having about thirty-three square feet of grate surface, in order to make the time the engines were forced to the extent of burning two hundred pounds of coal per square foot of grate per hour. With a wide fire-box boiler, to do the same work, the rate of combustion should be from 125 to 150 pounds per square foot of grate per hour or less, certainly a more economical performance.

THE PRESIDENT:—Mr. Turner, do you want to say a word or two on this subject?

MR. TURNER:—Not at present, Mr. President.

THE PRESIDENT:—Mr. Mackenzie, do you want to say a word?

MR. MACKENZIE:—No.

THE PRESIDENT:—Mr. Williams?

MR. WILLIAMS:—Nothing, Mr. President.

THE PRESIDENT:—We do not want to let this subject drop without further discussion, gentlemen. We have about 90 per cent. of our engines with the wide fire-box and I must say that it was a great disappointment to me when I found that we could not run larger exhaust tip than I had formerly been used to running on other roads, and this statement that only about one-third of the force of draft is available in the front-end has illustrated, to my satisfaction at least, why we cannot do that. It has also straightened up another matter

that has always been a mystery to me, and that was the difference in the soft-coal burning engines on different divisions; if it is a fact, as it now appears that these conditions exist, coal that will clinker to the grate must necessarily lose a great deal of its draft force. I have seen clinkers taken out of the fire-box from some qualities of coal that we have on our road that would take a bar to break it up. It would be almost like slag from a furnace. Other coals that we get produce no ash or no clinker and we must necessarily get a better result with a coal that there is a free circulation of air through than we would with a mass forming a body of clinkers. And this explains, in a great many cases, why the same arrangement of front-end on one road does not produce the same results on others. I remember two or three years ago we had nine engines of a certain build that never steamed freely. They had a single exhaust; they came from the works with a single exhaust; and we parallel the Erie at our Middletown shops or station, and the traveling engineer, whom I knew very well, said to me one day that they were making some changes and putting in a double exhaust and that they were getting wonderful results out of some of their engines; and he sent me a little rough sketch of what their arrangement was and we applied that to the next three engines that went through the shop and we had surprising results. The fourth engine did not do as well, and we never were able to do with the other engines as well as we did with the first three engines that we changed. I never could understand it, but find now that it was a great deal in the fuel. The engines were not all on one division and am I satisfied that the fuel that we got which obstructed the draft had a great deal to do with it. It seems to me this is too important a subject to let drop, gentlemen, and there are a good many members here who are capable of discussing this matter and would draw out quite a discussion if they would once get the ball rolling. I wish Mr. Mackenzie would say a word on this subject —start the boys going.

MR. MACKENZIE:—Mr. President, I would like to say a word here—

THE PRESIDENT:—I knew you did.

MR. MACKENZIE:—I want to get Prof. Goss up again. It is

with reference to the proportion of a tapered stack. The Professor says that the stack diameter should be divided by 4, as to the diameter of the front-end. It would seem then that a 17-inch cylinder with a 54-inch front-end or an 8-inch cylinder with a 54-inch front-end, would require the same size stack, and there is nothing said here as to the diameter of the cylinder in proportion to the diameter of the stack. I think there is a good deal in that, when you come to look it up, because of the fact that on the line where I was employed for some years we used the same size stack on a 13-inch cylinder as we did on a 19, but, as the Professor said, we changed the length of the stack in proportion to the cylinder; but with us, with a larger engine the boiler was higher and we had to make the shorter stack, where it should have gone the other way. I noticed again here—Mr. Pomeroy brought it out—I am a little off on my hearing; I didn't hear whether on the front-end arrangement as stated here on page 13 by the Professor,—"a front-end arrangement which is efficient at one speed will be found efficient at all speeds." Now, does that mean that as the speed increases the load decreases, Professor? What I want to know is this: If an engine will haul, we will say, for instance, a thousand tons twenty-five miles an hour, how many tons would she haul at twice that speed? Now, the load would be proportionate to the speed, would it? I would like to ask the Professor if they have made any experiments with the bridge in the stack instead of in the nozzle? It is a fact, you know, that we can get the same results in the stack. We had a very funny experience at one time. We had a fire claim and they said that the cause of the fire was that the stack was cracked and that the sparks came out through the side of the stack and set the fire on the right-of-way. Come to look into it there were quite a number of cast-iron stacks cracked. I wanted to know what the trouble was. They said the men had been putting bars of iron in their stack—cut them off and dropped them down as far as they would go in the tapered stack; when the stack got hot the bar would drop down a little further and when it got cold it would crack the stack. We soon did away with the bar in the stack. We had to renew all the stacks on account of the fire. I think there was something else I wanted to ask. I question very much the Professor's determination as to the amount of taper required on a stack—two inches to the foot. It seems to me that is

entirely too much. We found very much better results with an inch-to-the-foot.

THE PRESIDENT:—Now you see, gentlemen, Mr. Mackenzie thought he couldn't talk, and you see how well he has done. Now I believe a great many more of you could do just as well if you would just try it. We want to draw out some information from the Professor while he is here.

MR. MELLON:—We have on the Lackawanna, Mr. President, a great many engines with wide fire-boxes, and I think that we burn fine anthracite coal more successfully than any other road in the anthracite region. Three years ago we received a new class of passenger engine from Schenectady and they did not steam well. After a long series of experiments we had to abandon the single nozzle with which they were equipped and put in the double and change the choke-stack to a straight stack, and in all our experience we have found, and we have tested the single exhaust year after year—we have had to abandon it and I would like to have the Professor explain in reference to the necessity of using double nozzle on anthracite burning engines.

THE PRESIDENT:—Before the Professor answers your question, I want to make a statement in connection with the statement Mr. Mackenzie made in regard to stacks. I was with the Erie from '86 to '90 and during that time they adopted one stack for all sizes of engine, from a 16-inch cylinder, 16-by-22, to a 21-by-28, and one size grate. I am not crowing about the results.

MR. THOMPSON:—Mr. President, the front-end question has been and is now being thrashed out by such prominent men as Robert Quayle, Prof. Goss and a few others, and they are bringing out so many new features that I feel unable at present to offer anything new on the question.

The Traveling Engineers' Association have also been working on the question for the past three years, and it is one of their subjects for next year. However, it is a well-known fact in this country, that the Michigan Central engines, as a whole, are the best steaming engines in the country. We have some of the Michigan Central men here to-day and I would like to have them tell us about it.

THE PRESIDENT:—Is there a Michigan Central motive-power man here?

MR. MEADOWS:—Mr. President, I suppose Mr. Thompson is alluding to me. I know the Michigan Central has pretty good steaming engines. We use both the tapered and straight stacks. On our more modern power we use the straight stack entirely. There is one question on this paper I would like a little information on from Prof. Goss. On page 13 the paper reads: "An equal degree of efficiency can be secured by means of either the straight or tapered form of stack. As a problem in design, the tapered stack is the more simple since its diameter for best results is not affected by changes in height." That is not quite clear to me. I do not just understand where the advantage comes in with a tapered stack. Several other gentlemen have dwelt somewhat on that question and I would like to hear from the Professor as to where the advantage comes in with a tapered stack.

PROF. GOSS:—Perhaps I can answer the question at this time better than by waiting until all questions have been asked. The fact seems to be that for maximum efficiency, the diameter of the straight stack must change when the height is changed, whereas the diameter of the tapered stack remains unchanged as the height is changed. It is to this fact only that the statement questioned refers.

MR. MEADOWS:—I would like to ask you another question, Professor: Is it the correct idea to have the exhaust steam fill the stack or nearly fill the stack at the choke or at the top? Which do you think gives the best results? I would infer from this that the steam probably nearly fills the stack at the choke or the narrowest point in the stack. Is that correct?

PROF. GOSS:—The conception that the exhaust steam must fill the stack at the choke or at a point near the base was for a long time the controlling principle in stack design, and much work was done before it was discovered that the jet of steam could not be made to fill the stack until it nearly reaches the top. If the stack is contracted in an attempt to meet the jet, the latter will itself contract. The fact is that there is an enveloping layer of smoke-box gases

which follow the jet up into the stack and make impossible any contact between the jet and the sides of the stack. The fact that the jet retains its form within the stack as well as below it, probably accounts for the results obtained by the use of a bridge in the stack, which, however, is an arrangement of which I never before heard. The action of the bridge is, I imagine, much the same wherever it may be applied. Mr. Quayle's committee discovered that an engine which was a poorer steamer could sometimes be improved by means of the bridge on the exhaust tip, but that its effect on the back pressure was such that the whole arrangement was less efficient than such a reduction in the diameter of the exhaust tip as was needed to give the result required.

THE PRESIDENT:—Doesn't that statement of Mr. Mackenzie also prove that that condition does exist?

PROF. GOSS:—Yes, I think it does.

THE PRESIDENT:—That it must be near the top?

PROF. GOSS:—Yes.

THE PRESIDENT:—It could not have that effect if it were otherwise.

PROF. GOSS:—I think it does. If you will turn to page 4, you will find a sketch of the exhaust jet based on actual measurements. You will see that the reduction of pressure in the smoke-box is represented by 2.54 inches of water. With this condition existing in the middle of the front-end, there was near the base of the stack a draft of 3.61; that is, the point of lowest pressure of the whole steam is in the stack—not in the front-end but in the stack. Other readings given on the figure show that it is only at the top of the stack that the reduced pressure entirely disappears. This is probably true for any form of stack. It is only when the jet is upset by contact with the atmosphere that it fills out against the sides of the stack.

MR. POMEROY:—Is it not true that Mr. Deems, when on the Burlington Road, made road tests with suitable guages for obtaining

vacuum readings at the different points of the stack, which confirmed the results shown on Fig. 1?

PROF. GOSS:—Experiments have shown that an attempt to make the jet come against the stack at its base by reducing the diameter of the stack results in a corresponding reduction of the diameter of the jet, which, as I have already described, persists in keeping away from the side of the stack.

THE PRESIDENT:—How do you explain this statement, Professor, or the conditions which Mr. Pomeroy mentioned on that Northwestern engine? I know four or five years ago—it may be longer—we were getting coal from the Beach Creek Railroad and we were not getting good results; and they sent Mr. Ames, who was at that time master mechanic of the Beach Creek, over to see what our trouble was, and one of his first suggestions was that we take what we call the clinker cap off, which was of about six inches diameter, and run that open. He said that he was running that on all his engines; he was running a six-inch opening right in the bottom of his smoke-arch and our master mechanic went there on the Beach Creek and he found those conditions to exist; that all their so t coal burning engines—and they were quite all that kind—were running with that cap off with a six-inch opening right in the bottom of the smoke-box.

MR. MELLON:—I wish to confirm your remarks, Mr. President. On the Buffalo division of our road, about five years ago, they had a 2½ inch hole in the bottom of the cinder valve, which was open a greater part of the time.

PROF. GOSS:—Mr. President, I cannot explain that.

THE PRESIDENT:—Those are facts.

PROF. GOSS:—Such things are possible but I cannot explain them. Of course, if we consider the front-end mechanism of a machine to which is given the work of drawing forward the furnace gases, then the conditions described simply give added work to the machine. They are similar to those which would prevail about a pump having a hole in its suction-pipe. Of course, there may be some local conditions by virtue of which the jet was made more efficient by the

admission of the cold air, but as a general proposition, the statement appears absurd.

THE PRESIDENT:—I think Mr. Macbeth was master mechanic when that division was taken over. Didn't you find those caps off?

MR. MACBETH:—What?

THE PRESIDENT:—An opening in the smoke-box of the Beach Creek engines, with a funnel running down below the truck axle, no cap over the opening at all?

MR. MACBETH:—I am exactly in the same position as Prof. Goss. I have been trying to figure this matter out for the last fifteen years. It is a fact that all of our front-ends that showed a leak would immediately burn up the front-end, warp the sheets or the front, while at the same time it is fact that the Beach Creek and the Fall Brook had that cap taken off entirely, and in the experiments that they made it was a success. As Prof. Goss said a moment ago, it has been a matter that I have never been able to solve. Where you get a leak one way it is disastrous, and you take off caps making a six-inch opening and it proved a success. As you said a moment ago about Mr. Ames, they had that running at the time, and I am unable to explain it.

MR. BARHYDT:—Mr. President, this discussion brings out a great many good features. We try to maintain a uniform standard in our front-end and in the draft-appliance. We get the best authority possible on the subject and our practice on the road that I am connected with is to get the best information upon which to base our design. We maintain uniform standards in our draft-appliance, and those who would disturb it, without our knowledge, possibly might get into difficulty. But if we control the fuel conditions in the same manner that we control the draft-appliance, I believe that as far as a good steaming engine and a poor steaming engine are concerned we would have but very little trouble. In the conducting of experiments of this kind, if a fuel is maintained on one basis then we get one result, but if there are many kinds of fuel, then we must have a universal arrangement of front-end and draft-appliance that

will fit all kinds of coal. Furthermore, the size of the front-end, its cubical contents, is one thing at the beginning of a trip and before the trip is over the cinders are in the front-end and the conditions change there again. While these designs are very good, I believe, in order to get the best results, we should have control of the fuel as well as to have it uniform.

THE PRESIDENT:—Mr. Mackenzie.

MR. MACKENZIE:—I was just going to ask, Mr. President, one question of the Professor about the arrangement of the front-end. As I understand it, from the cuts here, there is no lift pipe inside of the arch?

PROF. GOSS:—The lift pipe, as far as I know, has not been investigated by anybody.

MR. MACKENZIE:—How is that?

PROF. GOSS:—There is no data that I know of which will guide in the design of lift pipes, which accounts for their not being included.

MR. MACKENZIE:—I thought perhaps that might have something to do in the results which you found in the taper per foot in this test.

PROF. GOSS:—Possibly.

MR. POMEROY:—The cut of the stack and front-end arrangement which I have before me and which I understand the Master Mechanics' Committee recommended, shows a lift pipe.

PROF. GOSS:—Yes, for a specific diameter of front-end, stack and height of nozzle. It has not been worked out as a general proposition. These illustrations which Mr. Mackenzie refers to are of general application.

THE PRESIDENT:—We have with us two gentlemen who have had a good deal of experience with these different arrangements after

they have been put in front-ends of the engines—Mr. Owens and Mr. Tunkey. Mr. Tunkey, can't you give us the benefit of your experience in handling these engines?

MR. TUNKEY:—I haven't anything special to say, Mr. President. Mr. Gould and I were talking over old times, and I was just wondering why it was that we never sparked any engines until we had cylinders in the front. When an engine did not steam we put on an inch smaller stack and we had no more trouble.

THE PRESIDENT:—Mr. Owens?

MR. OWENS:—Mr. President and gentlemen, I am a little behind on the draft question and I haven't come in contact with it for the last two or three years; but in hearing the discussion here I am unable to solve one condition and that is, on the road I was connected with a few years ago we had some new engines, wide fire-box and a single nozzle, a high nozzle; we couldn't get the engines over the road; they wouldn't steam. We took those nozzles out and replaced them with a low double nozzle and that nozzle is being used to-day and is a decided success, and I attribute the success to filling the stack at the base, and that seems to be right contrary to the discussion we have just had here, and consequently I cannot understand why it is that they are getting such good results out of a single nozzle all over the country to-day and we couldn't get along with it at all.

MR. POMEROY:—Those were hard coal conditions, weren't they, Mr. Owens?

MR. OWENS:—Hard coal; yes, sir.

PROF. GOSS:—You undoubtedly made an improvement in the front-end when you lowered the nozzle. That, perhaps, will account for the result.

MR. OWENS:—But I understand, Professor, that to get results we want to fill the stack at the base. The lower we reduce the nozzle the lower down we fill the stack.

PROF. GOSS:—Well, that may be one way of stating it. I do not think it will be found feasible in actual design to fill the stack at any

point; but assuming this to have been done, the paper makes it clear that any lowering of the nozzle will improve the draft.

MR. OWENS:—Well, my understanding is, Professor, that the lower down you spread the exhaust, the more inches of vacuum you create.

PROF. GOSS:—Yes, that is correct.

MR. MCCARTHY:—Mr. Barhydt a few moments ago stated, Mr. President, that the quality of the coal was the key of the situation, and I believe he is pretty near right about it. We on the Canada division of the Michigan Central find the same experience. We are running with a 5¼ nozzle tip on some of our wide fire-box engines, these engines making 510 miles a day. Some of the engines are putting in as high as 13,000 miles a month between Buffalo and Windsor. Our front-end arrangement is looked after by Mr. Meadows, and if we find a defect we do not let up on it until it is remedied. Mr. Meadows gets out on the road, stays with that engine if it takes a week to do it. The same is true in Michigan. Engines are followed up very closely by Mr. McBain, and I believe that the attention that both these gentlemen are paying to the front-ends is what is bringing our great success in engine steaming.

THE PRESIDENT:—I should think you had ideal conditions, if you can accomplish that.

MR. THAYER:—Mr. President, I notice from the remark that was made just a moment ago, the engine with the low tip or low nozzle is supposed to be the advantageous one, but the experience of the Wabash on the Buffalo division has been different. We brought our engines over from the Fort Wayne shop, Eastern division, with a modification of the Master Mechanics' front-end in them, and with the coal that we have on the Buffalo division we had to take that out and put in what we call the Grand Trunk front-end, and that has a very high nozzle. The nozzle-box tip comes within twelve or fourteen inches of the top of the front-end. Those engines have given good satisfaction with the high nozzle, whereas with the low nozzle we couldn't get steam at all.

THE PRESIDENT:—No other changes?

MR. THAYER:—Cut the front-ends out entirely and put in the Grand Trunk front-end.

MR. MACKENZIE:—No petticoat pipe in that case?

MR. THAYER:—No petticoat pipe. The petticoat pipe was taken out.

THE PRESIDENT:—Was that the only change that was made?

MR. THAYER:—So far as I know it is.

THE PRESIDENT:—Now, gentlemen, we want every one to speak.

MR. MACBETH:—I just wanted to ask Mr. Tunkey, stating that his engines steamed so long as they cleaned the front-end, what size mesh of netting he used? It might be one to the inch or it might be three to the inch.

MR. TUNKEY:—Mr. Macbeth didn't understand me. The engines throw no fire.

MR. MACBETH:—Throw no fire?

MR. TUNKEY:—Yes.

MR. MACBETH:—I have never found an engine that steamed freely that did not throw any fire.

MR. TUNKEY:—Well, a little bit.

MR. MACBETH:—"A little bit!" Where you find an engine freely steams it is throwing fire all the time and that is the only way you can clean the front-end. The point is that you take on seven to nine tons of coal into a tender and then undertake to put it all into the front-end of an engine. That is something that has never been done successfully. You have to get rid of the slate and stone, etc., and any front-end that cannot get rid of it, where the coal is of a poor quality, certainly will not steam. There has never been any question that where you are confined to three meshes to the inch,

you should have a draft pipe in there to clean off your netting, where you can't get steam. That has been a factor that has been gone through. The records of the Central Railway Club will show where I went through that matter very thoroughly years ago.

MR. TUNKEY:—I guess Mr. Macbeth never saw the latest equipment of the Lake Shore road. He will find that there is not an engine there that has any spark in at all. There isn't a place to let a spark out, and I am sure they do not open the front-end and shovel it out. Of course, there is once in a while a spark of fire but not a hundredth part of what there used to be in the engines that we used to let the sparks out of at the front-end. We have no passenger engines that we spark. On old ones that had sparkers, they riveted a piece of boiler-plate underneath where the sparker was.

MR. MEADOWS:—Speaking on the line of the controversy, between Mr. Tunkey and Mr. Macbeth, and also the gentleman here from the Wabash (Mr. Thayer), we run parallel, I believe, with the road you are speaking of; that is, the Michigan Central runs parallel with the Wabash. On our later engines the front-end is 72 inches in diameter and the exhaust pipe is 20 inches high, and on that a tip 4½" high sets; that makes the exhaust opening 24½ inches high on a 72-inch front-end. We use a modified type of the Master Mechanics' front-end. We also use a draft-pipe, a double draft-pipe, and in some cases the draft-pipe is in three sections; and those front-ends are absolutely clean.

THE PRESIDENT:—You do not spark them?

MR. MEADOWS:—We do not spark them; no arrangement for sparking them. I will guarantee that when the front-ends are open for washing purposes, which is about the only time they are opened, that you can put the sparks in your hat, all that are left in the front-end. Now, with reference to what Mr. Tunkey said, I will guarantee in riding over the road on any of our fast trains—and we have got pretty nearly as fast as any of them—that you won't see over from six to twelve sparks flying out of that stack at any one time. I won't say they do not throw any fire, but with the older engines that we had to spark, there was a constant stream of fire, as Mr. Macbeth

says, all the time. My experience has been with the engines that you have to spark, that they fill up to probably within six inches of the netting on a line with the netting. Now, after that is filled you have got to pull your sparks out. There is not an opportunity for them to be ground up, as Mr. Tunkey said. We throw any amount of dirt out of the stack but the sparks are pretty well broken up and the life is out of them.

THE PRESIDENT:—That has been my experience; that the engines that arrest the sparks in the front-end are the engines that throw the fire. An engine that will clean the front end won't throw nearly as much fire as an engine that arrests the sparks. When we first started out with the extension front-ends, we thought we were going to arrest those sparks, hold them, and at the end of the trip clean them out. As Mr. Macbeth says, we put in nine or ten tons of coal through those flues, probably one-quarter of it is unconsumed until it reaches the smoke-box, why, we couldn't help but throw fire. But I think we are working on entirely different lines now. We aim to paddle those sparks in the front-end until they are dead or lifeless at least, so that they cannot set fire. They may look red but there is not heat enough when they strike the ground to do any damage. Now, gentlemen, have all spoken who wish?

MR. OWENS:—Mr. President, I might say that I think this spark question is due to larger boilers, larger front-ends. Take the old anthracite coal-burning engines. In order to get steam it is just as Mr. Macbeth says, you have got a stream of fire up there. That means that you have to stimulate the fire much stronger than you do on the larger engines. In regard to condition of netting, there is one more condition that enters into a good steaming engine. It may be a little out of order here, but a certain locomotive works built six of their first wide fire-box engines about three years ago. They were sent out to a western road, burning a poor grade of soft coal. I happened to be at those works and the builders asked me if I had any suggestions to offer, and I offered a suggestion: That was a coarser grate. They had a grate there that was really less than $\frac{3}{8}$ inch opening between the bars. But the change wasn't made. Those engines went out west and were run for about two months. They had all kinds of netting in them and all kinds of nozzles but they did not

steam. Consequently they followed my suggestion of putting in the coarser grate and they could get all the steam they wanted with most any kind of a nozzle and most any kind of a netting unless it was too fine, so that I think the grate question enters into the steaming qualities to a great extent, especially on wide fire-box engines where they get them rather narrow.

MR. TURNER:—In the opening of the discussion Mr. Pomeroy asked relative to the double and single nozzle. I would be pleased to have the Professor state why he prefers the single over the double nozzle. I haven't heard that remark answered yet.

THE PRESIDENT:—Professor, do you feel like answering that question now?

PROF. GOSS:—Well, I am not the committee. I merely quote the committee. I think, however, that the committee was influenced by the fact that the double nozzle delivers a stream which has a larger cross-section and which is more spread out than that delivered by a single nozzle. They had stated as a principle that the more solid the jet, the greater its efficiency so that when their experiments failed to give a clear indication they very properly had recourse to a general principle.

MR. MELLON:—Might I ask the Professor: Were any of these tests conducted with anthracite coal for fuel?

PROF. GOSS:—The Northwestern tests were not. Nothing that has been done at Purdue has been. I want here to emphasize the fact that nothing which I can say or have written can in any way cover this question, because when certain propositions are made, and certain conditions fixed, and the problem appears to have been solved, then some change of condition pops up and the whole thing goes by the board. From the point of view which I have had in this discussion, I do not understand that the grate or the character of fuel has any very close connection with the subject. They have a bearing on the steaming qualities of a locomotive, but I have not been discussing the question of the steaming of a locomotive. I have regarded the front-end mechanism simply as a machine for moving gases. The

effort has been to so proportion this machine that the greatest volume may be drawn against a given difference of pressure, with the least possible back-pressure upon the engine. That is all. Of course, if the grate is close, there must be a greater difference of pressure to bring air through, and to maintain this greater difference of pressure the front-end must do more work. To make the front-end do more work it should not be necessary to change its design. The only thing that should be necessary is to reduce the diameter of the exhaust tip. When other things are right, the tip is the one element by the adjustment of which the varying conditions of fuel and of grate area are to be met. If to burn hard coal a stronger draft is required than for soft coal, the one change which should be made in the ideal front-end when the locomotive goes from soft to hard coal is a slight reduction in the diameter of the tip. I am not sure that I have made myself clear on this subject. It is not an easy one to present but I have tried to show that there is a difference between efficiency of front-end and the steaming of a locomotive. Perhaps I can sum it all up by saying that when the design of the front-end is perfect, the question of steaming becomes merely a matter of the diameter of the nozzle.

The statement in the paper that the efficiency is not dependent upon the condition of running means that if a front-end arrangement is efficient under one condition of running, it will be found to be efficient under all conditions of running. In other words, when by repeated trials a front-end has been found which gives good results when the engine is run under a certain cut-off and at a certain speed the question at once arises as to whether the arrangement in question will prove satisfactory at other cut-offs and at other speeds. The paper answers this question in the affirmative. It states that an arrangement which works evenly for one speed and one condition of running will work with relatively the same efficiency under all conditions of running.

The question has been raised as to whether the cylinder is to be regarded as a factor in the design of the front-end. I do not think that it is. We have a sufficient number of variables already and if we can keep the cylinder out we ought to do it. The demand for steam is upon the boiler and that demand is met by the furnace in response to a condition of draft that is brought about by a jet of steam which comes from the boiler. Now, it doesn't make much

difference whether that steam which forms the jet comes through cylinders of one diameter or of another diameter. So far as the action of the boiler is concerned in its relation of furnace to front-end, it is complete in itself. My belief is that the cylinder has no more to do with the design of the front-end than the steam pipe.

MR. POMEROY:—There was one question I do not understand was answered; *i. e.*, to what limiting conditions were the Master Mechanics' Committee investigations confined, and the scope of the investigations of the so-called American Engineer Tests.

PROF. GOSS:—The limitations upon previous committees have not been arbitrarily defined. The committee have, however, found limitations in the time and means at their disposal. For example, the committee of which Mr. Quayle was chairman, spent almost all its energy on the exhaust pipe and the tip. They did do a little work on the stack, but not enough to justify them in making any general conclusion. They were satisfied to get the exhaust pipe so well defined that it will never be necessary to do it again and in this they did a great work. The present committee has two chief purposes. One is to check, by means of engines having large diameters of front-end, those results on the stack which were obtained in the American Engineers' tests, and the other is to develop information concerning those details of front-end which have not yet been settled, as for example, the draft-pipe and the inside stack.

THE PRESIDENT:—Gentlemen, we will have to draw this discussion to a close, as we have another paper. And I know we all feel very grateful to Prof. Goss, coming way over from Lafayette here to give us this paper and to be so free and willing to answer all the questions that have been brought out, and I feel that we have all been benefitted very much by this discussion and a vote of thanks would be entirely in order.

MR. OWENS:—I make a motion that we extend Prof. Goss a vote of thanks.

(Seconded and carried unanimously by a rising vote).

PROF. GOSS:—Mr. President and gentlemen, I certainly thank you for this expression of your appreciation, and I am glad to say that any pleasure which you may have found in my presence with you cannot, I am sure, equal the pleasure I have found in the hospitable reception you have accorded me. (Applause).

AMENDMENTS TO THE CONSTITUTION.

THE PRESIDENT:—The next in order is New Business.

The Secretary then read the following:

BUFFALO, N. Y., November 13th, 1903.

Mr. Harry D. Vought, Secretary-Treasurer, Central Railway Club.

Dear Sir.—Notice is hereby given that at the next regular meeting of the Central Railway Club a motion will be made to amend Article IV of the Constitution by inserting after the name "Vice-President" the name "Secretary-Treasurer"; and by inserting after the words "These officers" the words "excepting the Secretary-Treasurer." And to amend Article VI of the Constitution by eliminating the words "shall have authority to appoint a Secretary-Treasurer."

Yours truly,

S. H. JONES.

THE SECRETARY:—The Secretary, to save time, has made a comparison of this with the constitution and by-laws and for the information of members will say that this means the making of the office of Secretary-Treasurer elective but not constituting him a member of the Executive Committee and depriving the Executive Committee of the authority given to them to appoint a Secretary-Treasurer.

THE PRESIDENT:—Any action necessary, Mr. Secretary?

MR. MOONEY:—I move, Mr. President, that the resolution be laid on the table. Carried.

THE SAFETY APPLIANCE LAW.

THE PRESIDENT:—Nothing else under New Business we will now receive the report from the Committee on Safety Appliance Law.

BUFFALO, N. Y., November 6, 1903.

To the Central Railway Club:

GENTLEMEN:—The Special Committee on Safety Appliances for the front ends of Locomotives and the rear ends of Tenders submit the following for your consideration:

The Law requiring these attachments reads as follows:

"Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled that the provisions and requirements of the Acts entitled, 'An act to promote the safety of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their cars with automatic couplers and continuous brakes, and their locomotives with driving wheel brakes, and for other purposes, approved

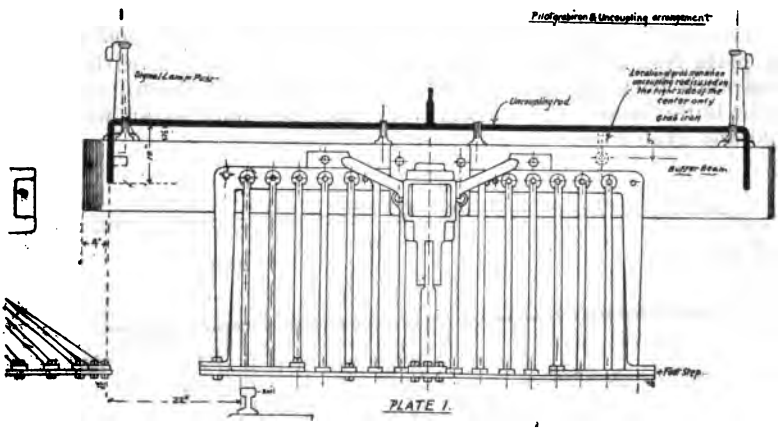


PLATE I.

March second, eighteen hundred and ninety-three, and amended April first, eighteen hundred and ninety-six,' shall be held to apply to common carriers by railroads in the Territories and the District of Columbia, and shall apply in all cases whether or not the couplers brought together are of the same kind, make or type; and the provisions and requirements hereof and of said acts relating to train brakes, automatic couplers, grab irons, and the heighth of the drawbars, shall be held to apply to all trains, locomotives, tenders, cars and similar vehicles used on any railroad engaged in interstate commerce; and, in Territories and the District of Columbia and to all other locomotives, tenders, cars and similar vehicles used in connection therewith, excepting cars and locomotives exempted by

the provisions of section six of said Act of March second, eighteen hundred and ninety-three, as amended by Act of April first, eighteen hundred and ninety-six, or which are used upon street railways."

The act covering grab irons on cars reads as follows:

"It shall be unlawful for any railroad company to use any cars in interstate commerce that are not provided with secure grab irons, or, hand holds on the ends and sides of each car for the greater security to men in coupling and uncoupling cars."

We find in our investigation, that, owing to the variety of pilot couplers used on locomotives, it is not practical to recommend a standard system of making and applying uncoupling rods and grab irons. The construction of the front end of each class of locomotive used, including the pilot and pilot coupler, has got to be considered to work out a design of both that can be applied and meet the requirements. This being true, we can suggest only in a general way what will apply to the largest number of locomotives we are familiar with.

An uncoupling rod made of 1 inch round iron, formed as shown in plate No. 1 of the attached drawing and applied with $2\frac{1}{2}$ inch clearance between the bottom side of the rod and the top side of the pilot buffer beam, will answer very well for both as an uncoupling rod and grab iron.

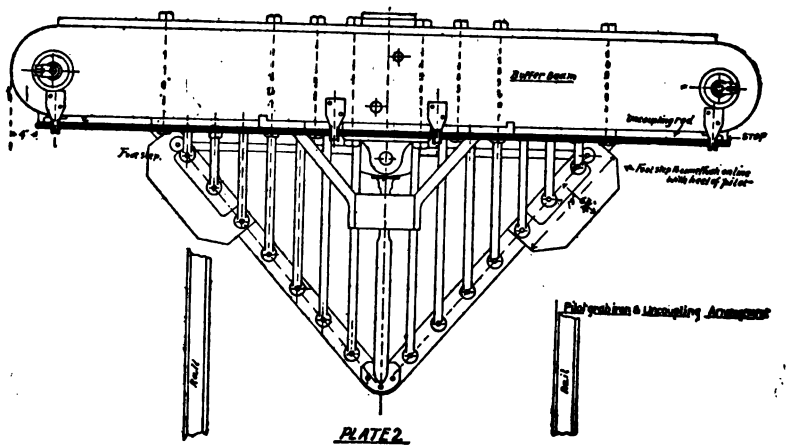
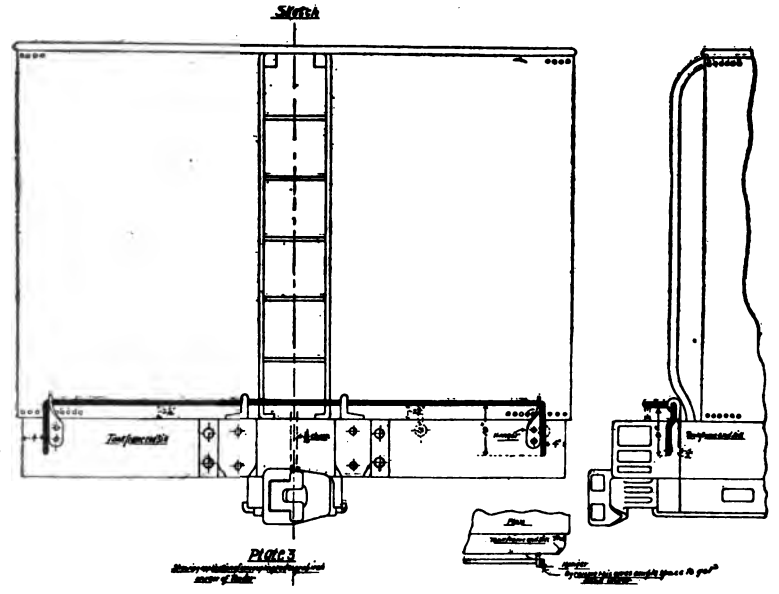


PLATE 2.

Where the uncoupling rod extends from one side to the center only, it can be raised up to give the clearance and used for a grab iron on that side. On locomotives equipped in this way, a grab iron made of not less than $\frac{5}{8}$ inch round iron should be applied to the

opposite side of the center, with lag screws, rivets or bolts not less than ½ inch in diameter. The grab iron should be of such a dimension that it can be applied to give 2½ inch clearance between the lower side of the iron and the top of the pilot buffer beam.

The uncoupling rod for the back end of tenders can be made on the same lines and applied so as to be used for a grab iron.



We find there is a very general opinion among motive power officials that grab irons on the sides of the front ends of locomotives and back ends of tenders are unnecessary. We are of the opinion that uncoupling rods and grab irons applied as suggested above will meet the requirements of the law.

The American Railway Master Mechanics' Association appointed a committee at their last convention, on location of grab irons on the front ends of locomotives. This Committee has completed and submitted to the members of the Association a report in which they include correspondence between the Committee and Mr. Edward A. Moseley, Secretary of the Interstate Commerce Commission. The report reads as follows:

American Railway Master Mechanics' Association.

OFFICE OF SECRETARY,
667 ROOKERY BUILDING,
CHICAGO, ILL., October 26, 1903.

To the Members:

Herewith is transmitted the Report of the Committee on Location of Grab Irons on the Front Ends of Locomotives, and also copy of subsequent correspondence between the secretary of the Interstate Commerce Commission and the chairman of the committee.

Yours truly,
JOS. W. TAYLOR,
Secretary.

INTERSTATE COMMERCE COMMISSION.

OFFICE OF THE SECRETARY.

WASHINGTON, October 16, 1903.

Mr. C. H. Quereau, Superintendent of Shops, New York Central & Hudson River R. R. Company, West Albany, New York:

DEAR MR. QUEREAU.—Your letter of October 3 enclosing a proposed report of the American Railway Master Mechanics' committee on the location of grab irons on the front ends of locomotives is received. I telegraphed you a few days ago that I hoped you would hold your report for a short time and that I would take occasion to write to you fully on the subject. There is really no necessity for haste, as the Commission has fixed March 1, 1904, as the limit of time within which railroads may comply with the requirements for grab irons upon locomotives.

In your report you seem to indicate that the conclusions there stated are based largely upon views expressed by a representative of the Interstate Commerce Commission. If the Commission, or its representative, is to bear any portion of the responsibility I beg that you will set forth in the report what the views of this representative are and the reasons why he has taken the positions indicated.

Personally, I do not think it requisite that the front ends of locomotives shall be equipped with hand-holds separate from a proper uncoupling lever; but I do believe that locomotives should be equipped with an uncoupling lever running from one side to the other of the front end of the locomotive, made of iron at least one inch in thickness, well bolted, and with a 2½-inch clearance (as outlined in your proposed report) so that under all circumstances the employes will be able to use such uncoupling lever as a grab iron. It is my belief that this would satisfy the requirements of the law for a hand-hold or grab iron on the front ends of locomotives, and that a grab iron on the side of a locomotive, near the front end, is unnecessary.

Although not required by the statute it is noted with satisfaction that your proposed report recommends the addition of a foothold or step on the pilot to be used by the employe in connection with the grab iron.

It should be borne in mind that the law requires hand-holds on the fronts and sides of locomotives unless this Commission relieves the carrier from such requirement. Notwithstanding the position taken by some railway managers

that hand-holds on the front ends of locomotives are unnecessary and are an element of danger, the Commission is not likely, in view of the contrary belief held by representatives of practically all railroad employés who are at risk, to relieve the carriers from this obligation. It appears, moreover, that a large number of railroad companies had equipped their locomotives with front end hand-holds before the law requiring such hand-holds was passed, and it is believed that the opinion of the mechanical men employed on the roads of those companies should also have consideration. The ideal condition would be that the employé should on all occasions be afforded facilities which would obviate the necessity of placing himself in front of the locomotive or at other unnecessary risk. As you are aware, and as was brought out at our meeting, such ideal condition frequently does not exist in actual practice; the trainman is often compelled by the exigencies of his employment to expose himself in this manner.

As long as the service subjects men to such risks, everything in the way of equipment which their practical experience demonstrates will safeguard their lives and limbs in the performance of their duties should be cheerfully provided.

It is believed that the use of a solid or rigid coupler, which does not open, is bad practice, and as it is understood that this is the unanimous opinion of the committee it should be noted in your report.

It was also the unanimous opinion of the committee, I believe, that road engines should not be used in yard service unless such changes are made as will fit them for that work. Following that view, is it not proper that the report should recommend the removal of pilots on road engines engaged in yard service; that the footboards and long uncoupling levers on the front ends of locomotives and rear ends of the tenders should be applied; and that the driving-wheel brake should be in good condition?

If the foregoing suggestions are adopted the Commission will undoubtedly concur in your report. As the report will probably be adopted as the recommended practice, and as such continue in force for a considerable period of time, there should be, I think, a complete understanding as to its provisions, and it should fully cover the matters necessarily involved in practical operation.

Sincerely yours,

EDWARD A. MOSELEY,
Secretary.

NEW YORK CENTRAL & HUDSON RIVER R. R. COMPANY.

WEST ALBANY, October 19, 1903.

Mr. Edward A. Moseley, Secretary Interstate Commerce Commission, Washington, D. C.:

DEAR SIR.—I have your letter of October 16, in regard to the report of the committee of the American Railway Master Mechanics' Association on "The Location of Grab Irons on the Front Ends of Locomotives." As chairman of the Master Mechanics' committee, I am obliged to you for your time and attention.

I agree with you that everything in the way of safeguards to reduce to a minimum the risks of trainmen in the performance of their duties should be provided and believe most railroads will willingly and cheerfully do this regardless of cost. If I correctly understand the case, the matter of the cost of

applying grab irons to the front ends of locomotives is not the main consideration in the minds of many Operating and Motive Power Department officials who consider their application at this point an invitation to employés to assume unnecessary risks by riding on the pilot.

In regard to the use of the solid or rigid coupler on the pilot, you are right in stating that our committee does not consider these complying with the law, but it seems best not to include this in the report on "The Location of Grab Irons on the Front Ends of Locomotives," for which our committee was appointed.

You are correct in saying that our committee was of the unanimous opinion that when it is necessary to use road engines for yard service the pilots should invariably be removed and standard foot-boards and proper hand-holds applied, both to the front end of the engine and the rear of the tender, and that the driver brakes should be in good condition. We are, however, of the opinion that this would be out of place in our report, as it is not covered by the subject we were appointed to investigate.

Yours truly,
C. H. QUERREAU,
Superintendent of Shops.

REPORT OF THE COMMITTEE ON THE LOCATION OF GRAB IRONS ON THE FRONT ENDS OF LOCOMOTIVES.

To the Members of the American Railway Master Mechanics' Association:

Your committee has acquainted itself with the requirements of the law regarding safety appliances, as it relates to grab irons on the front ends of locomotives in road service, as interpreted by the Interstate Commerce Commission and in the following report this has been kept in view. In addition to this, we have undertaken to answer the various questions raised by superintendents of motive power.

Your committee learns there is a widespread opinion among operating and motive power officials that grab irons and steps on the pilots of locomotives in road service, instead of being a safety appliance, are dangerous because they invite employés to place themselves unnecessarily in a dangerous position. This view was urged by your committee on a representative of the Interstate Commerce Commission, but without avail.

The law does not require the application of steps, either to the pilot or on the tender.

The law does not refer to hand-holds on the smoke arch, but to hand-holds or grab irons on the pilot or front bumper beam.

A grab iron at the front end of the engine, on the side, is not required.

The Master Car Builders' standards for grab irons on freight cars cover the following points, which we would recommend to apply in the case of grab irons on locomotives:

Grab irons should be secured by lag screws, rivets or bolts not less than ½ inch in diameter.

The diameter of the iron used for grab irons should be not less than ⅝ inch.

The clearance between the grab iron and the piece to which it is fastened should be not less than 2½ inches.

If the uncoupling rod meets these requirements, and has a diameter sufficient to give the required stiffness, it will answer as a grab iron.

If the uncoupling rod extends only from one side of the engine to the coupler, we recommend a grab iron on the opposite end, on the bumper.

If the uncoupling rod extends across the front end of the engine, no other grab iron is reqnired there. We recommend this construction.

A flag standard is not a satisfactory substitute for a grab iron.

Though a foot-hold or step on the pilot is not required by the law, inasmuch as grab irons are considered necessary, your committee recommends the application of a convenient step on the pilot, to reduce to a minimum the danger to employés riding the pilot.

Pilot coupler braces, to be satisfactory grab irons, should be at such a height and have sufficient clearance to be conveniently and surely reached by employés.

C. H. QUEREAU, Chairman.
W. S. MORRIS,
J. MILLIKEN,
Committee.

We have made some large, free hand drawings from those shown in the printed reports of the Proceedings of the last meeting of the Western Railway Club, to better illustrate how some of the Western roads apply uncoupling rods and grab irons.

F. W. WILLIAMS,
JOHN HOWARD,
WM. TUNKEY.

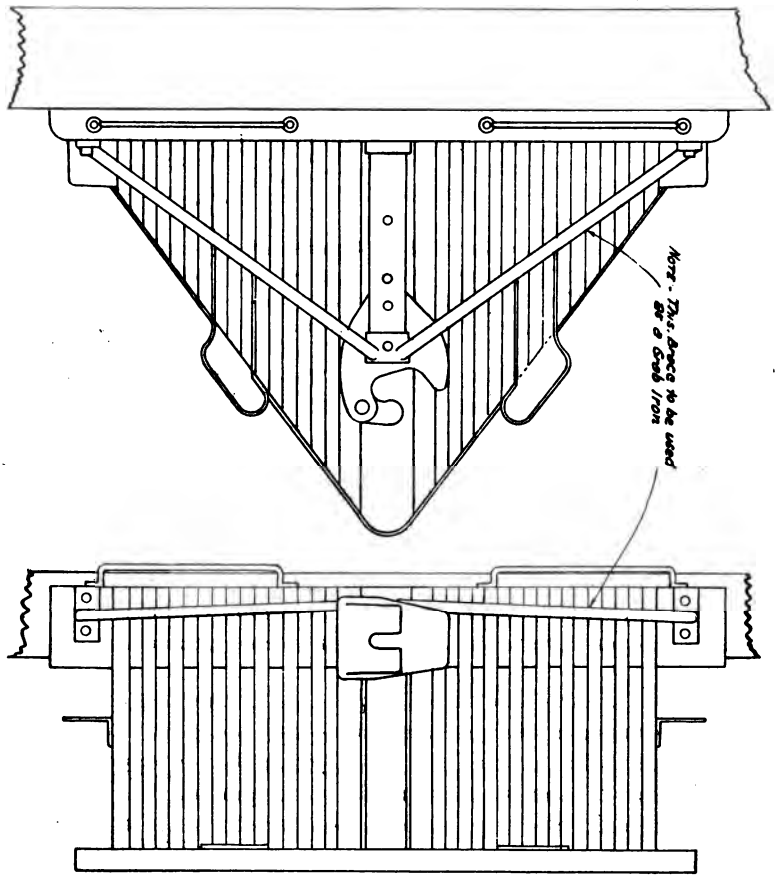
MR. MACKENZIE:—Mr. President, I move the report of the committee be received and spread upon the minutes. Carried.

THE PRESIDENT:—The subject is now open for discussion, gentlemen. If anyone wishes to ask any questions or criticise these arrangements, they are at liberty to do so; glad to have you. Mr. Williams, do you care to say anything in opening the discussion.

MR. WILLIAMS:—The object in presenting the free hand drawings, drawn on such a large scale, was to give the gentlemen present who wished to take part in the discussion, a better opportunity to see how some of the western roads were putting on the safety appliances; and, also, to make a comparison with the practice recommended in this paper.

The recommendations shown on the three drawings to the right show the uncoupling rod applied to answer for both an uncoupling rod and a grab iron. This reduces the number of parts necessary to apply to a locomotive and make these parts uniform on both ends of the locomotive, which is very important to a trainman when working with a locomotive.

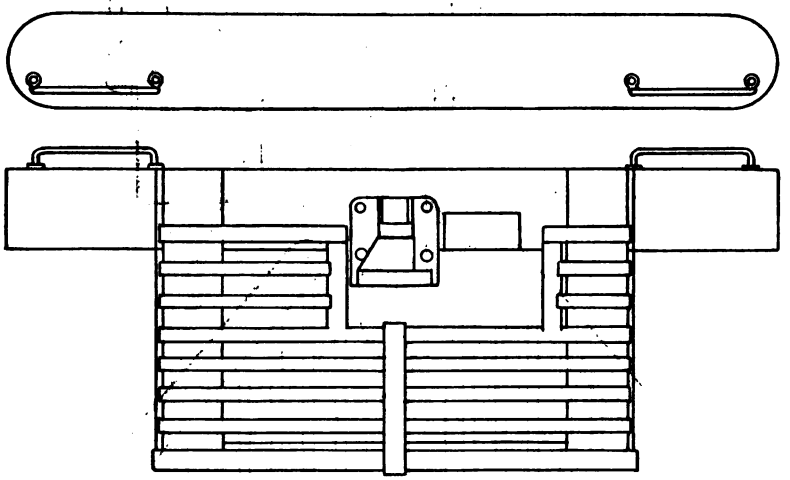
The positions of the uncoupling rods and the method of application to both the front end of the engine and the rear end of tenders are shown very plainly on the enlarged drawings and one can, in this



Arrangement of Grab Irons on Pilot
Vandalia Line

way, get a very good idea of how they will appear life-size, or on a locomotive in service. We thought it very probable that, in this way, we could bring out a much better discussion.

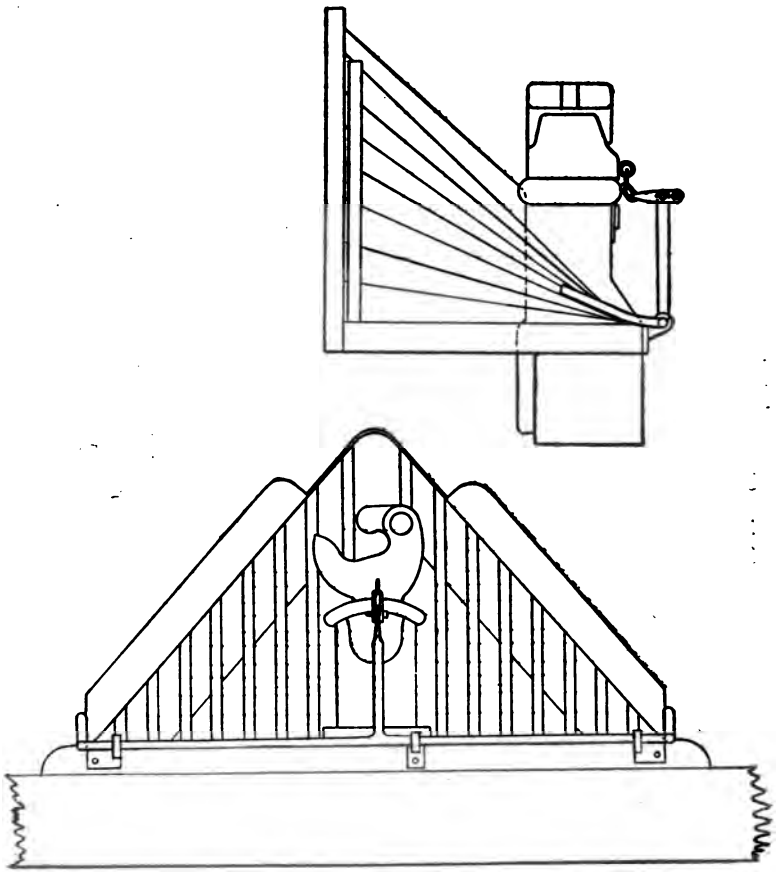
THE PRESIDENT:—I would say, for the benefit of the members, that Mr. Moseley was over to our place a short time ago and he called my attention to one matter in connection with this uncoupling rod which a great many roads had applied to their engines, running across from side to side on the back end and on the pilot end. When it was applied, it was not applied with the idea of ever using it as a grab-iron and it was placed very close to the end-sill. One of the points that the Commission was emphatic in demanding was that there should be room there for a trainman or anyone to grasp that with a glove; that a man might be able to grasp that uncoupling rod



Location of Grab Irons on Front Bumper Beam.
Sante Fe System.

an inch and a half or two inches if he were bare-handed, but in the winter time when his hands were cold and he had a mitten or glove on, that he would grab for it and miss it because he couldn't get far enough around to grasp it. Mr. Moseley strongly urged that instead of carrying out the arrangement which I notice of the uncoupling rod coming one-half across and the grab-iron on the opposite side, that an uncoupling rod should extend the full width of the tank frame.

MR. TURNER:—Do I understand that that is compulsory now; that they want us to run that rod clear across?



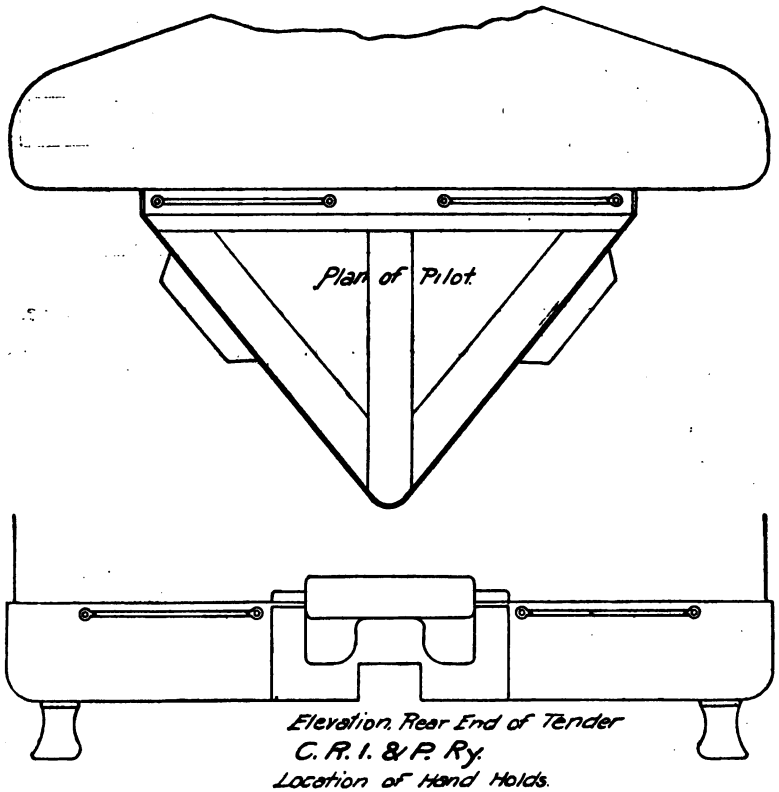
Uncoupling Lever and Grab Iron
D. & I. R. R. R. PILOT.

THE PRESIDENT:—Oh, no.

MR. TURNER:—You know, Mr. President, there are draw-heads; in fact we have some of them in use on our engines; also, the

uncoupling rod does not work from the top like that. I am speaking now relative to the Trojan coupler; we are all familiar with it. Therefore it would be impossible.

THE PRESIDENT:—Oh, no, they do not enforce that.

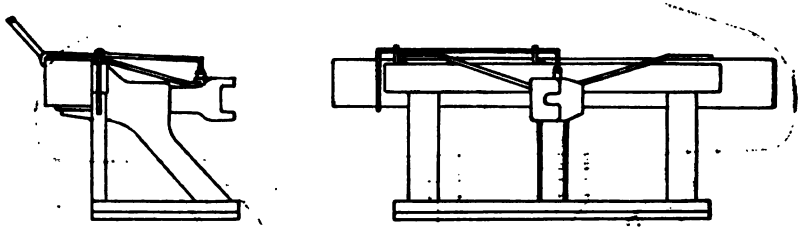


MR. POMEROY:—Mr. President, is my understanding correct that Figures 1 and 2, for the front end, and 3 for the back end, showing the uncoupling-rod carried clear across the beam, if the brackets permit of sufficient clearance for a man to catch hold of with a thick glove, complies with the law without applying special grab-irons in addition?

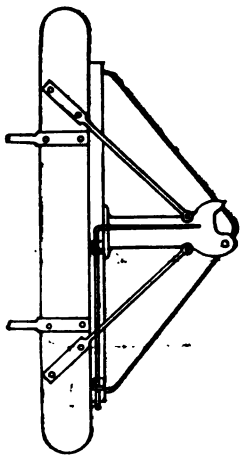
THE PRESIDENT:—Well, I do not know about the side. They do not ask for a grab-iron on the side.

MR. MACKENZIE:—I understand, Mr. President, that this is the recommended practice of the Committee—sketches 1, 2 and 3?

MR. WILLIAMS:—That is the recommended practice.

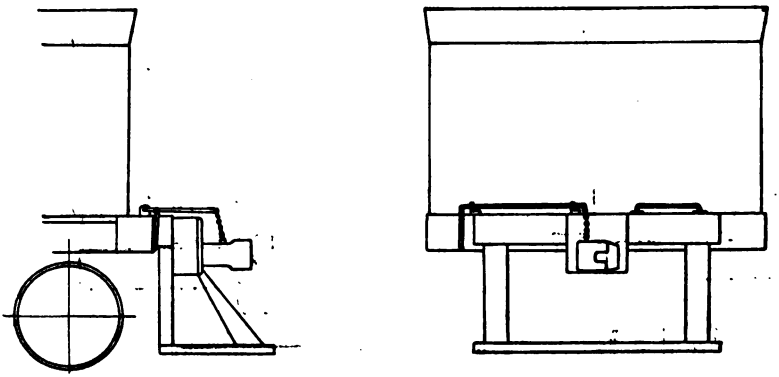


Location of Grab Irons Front of Engine.
C. & N. W. Ry.

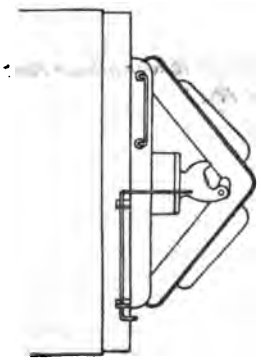


MR. MACKENZIE:—Well, I question very much whether a hand-hold should be an uncoupling lever. I believe that the coupling lever should be entirely independent from the grab-iron, and for this reason: You take their recommended practice on Plate 3; a man goes into the car and his hand is in about that position (indicating).

when he grabs a grab-iron. If he stumbles he has got all this lost motion in his arm and he is sure to go down to the track pretty near before he can recover himself. In the recommended practice of the Car Builders, the grab-iron is about 16 inches above the end-sill, so that if a man goes in there his hand is in that position (indicates)



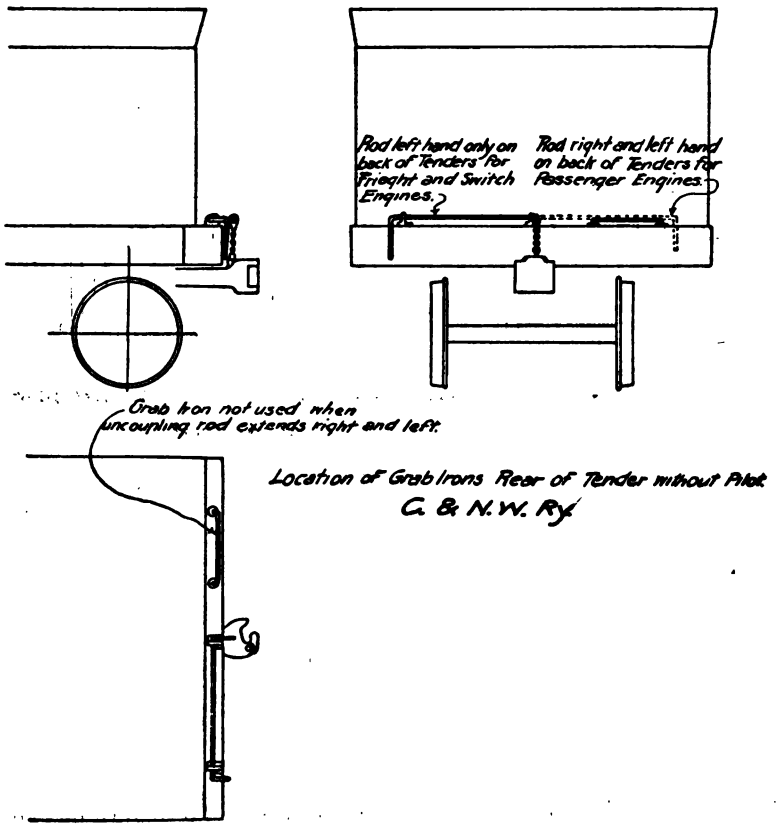
Location of Grab Irons Rear of Tender with Pilot.
C. & N. W. Ry.



and if he stumbles he does not have to go very far before he can recover himself; and we have known of cases where men have had their legs badly damaged by reason of trying to save themselves by the uncoupling lever. I think that the grab-iron should be placed entirely above the uncoupling lever and not have anything to do with it whatever.

MR. POMEROY:—How can you place the grab-iron higher on the front-end?

MR. MACKENZIE:—The front-end of an engine, with a pilot on is not used very much, I think. Therefore, it is more a matter of form than anything else. We do not have any uncoupling levers on the

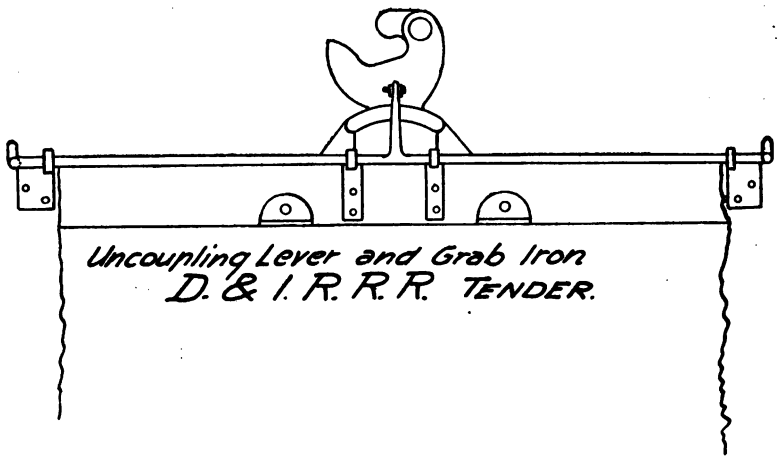

Rod left hand only on back of Tenders for Freight and Switch Engines.
Rod right and left hand on back of Tenders for Passenger Engines.
Grab iron not used when uncoupling rod extends right and left.
Location of Grab Irons Rear of Tender without Pilot
C. & N. W. Ry.

road where we are, on the front-end of our engines, where the pilot is used. We have a step and a handle and a ring in the knuckle and simply a man goes in there, lifts the ring and that uncouples the knuckle and lets it go. Now, I think the committee ought to give

us something recommending some practice for switch-engines. That is where the man goes between the tenders of the cars and between the front-ends and the cars a thousand times where they do once with these conditions now as shown, and I think that the committee should be continued and present a recommended practice showing the steps for the men, and the uncoupling lever and the grab-iron.

THE PRESIDENT:—As I understand the law, it is compulsory with railroads to have an extra rod in the front-end so that it is not necessary for a man to go in and lift, as you claim they do.

MR. MACKENZIE:—No, sir.

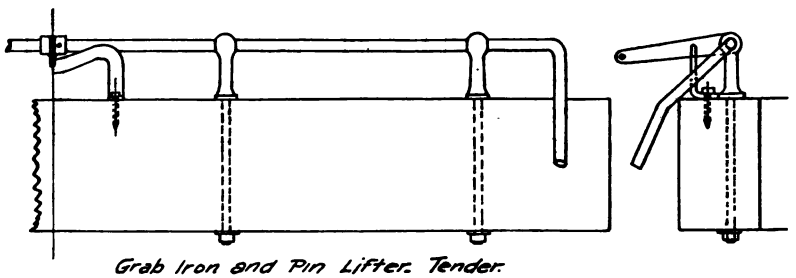


THE PRESIDENT:—And this law was to take effect on the 30th of September, was it not? and that is why such great haste was made, and not until after the 30th of September was the enforcement of the law extended. That is why such haste was made in arriving at some thing that would answer the purpose—comply with the law.

MR. BARHYDT:—Relative to the grab-iron on the back of the tender, Mr. President, using the uncoupling device as a grab-iron, it would seem that that would be a very good summer arrangement but not so good in the winter. I believe a great many will bear me out

in the statement that there is, as a rule, on the back end of engine-tenders in the winter time, a large accumulation of ice and it would seem to me that the grab-iron on top of end-sill would be useless in winter. Using two grab-irons on the back of the end-sill, standing out from the end-sill, would always be more of a grab-iron than the uncoupling device up on top of the end-sill.

MR. OWENS:—I would like to ask some members here if they do not think it is necessary to have the grab-iron on the buffer-beam there at least 24 inches high on the Mother Hubbard or Wooten fire-box type of engines? I know of a road that had those grab-irons on and removed them, and I considered it a very serious mistake for engineers and firemen, who have to get to and from the cab very often. It seems that the committee or sombody has really lost sight of that type of locomotive and I consider it, and I think everybody else who has had any experience on them will consider them absolutely necessary.

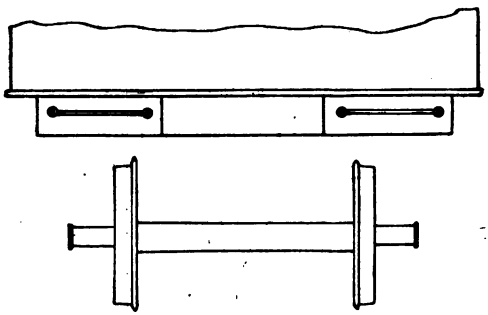


Grab Iron and Pin Lifter. Tender.
I. C. R. R.

THE PRESIDENT:—In what conversation I have had with the members of the Inter-State Commerce Commission, I have been to Washington twice and they have been to Middletown once (Mr. Moseley has), their idea is to keep everything as near uniform as possible, and their recommendations, what recommendation they offered, was that this arrangement on the front-end of the locomotives should be as near a flat-car arrangement as possible. Now, those conditions are allowed on a flat-car or even on a gondola; that an uncoupling lever or rod may be used as a substitute for a grab-iron, providing there is a clearance sufficient for a man to grasp

it with a glove or mitten on, and we all know that the nearer you can get grab-irons to a standard height so that a man can, day or night, know that if he puts his hand out he is going to grab an iron that will hold him, why, that is the main feature. It isn't whether it is twenty-four or forty-four inches from the rail providing he has something that he can rely upon and know about where to grasp it; and that, as I understand, was their idea of recommending these heights; that it would be as near the flat-car arrangement as possible.

MR. MELLON:—Mr. President, I believe Mr. Owens refers to that type of engine that has a step back of the bumper to the



Location of Hand Holds on Tender
Vandalia Line.

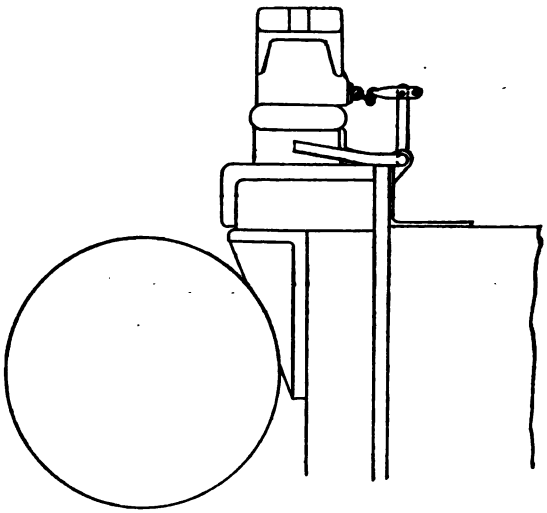
cylinder where the engineer and fireman have to climb up to the running-board and go into the cab from the front-end. All our engines are equipped with a signal post of sufficient height to serve as a grab-iron, as shown on Sketch No. 1.

MR. WILLIAMS:—Mr. President, in regard to Mr. Mackenzie's question about the grab-irons on the rear end of tenders. We found that there was a large number of locomotives in use with the tender frames extending back, some of them fully two feet beyond the back end of the cistern and, therefore, it was impracticable to attempt to use the grab-irons secured to the rear end of the tender cistern; and

as the paper states, the recommendations cover the largest number of locomotives we came in contact with. It does not cover all kinds of constructions, but the largest number.

THE PRESIDENT:—It used to be the practice to have a tank-box on the rear of the tender here.

MR. MACKENZIE:—Yes, sir; and I was going to explain it by saying that we know of cases where the draw-bar has been pulled out; it has been fastened as shown by the recommendation of the committee, to the combined rod, and it has broken the bolts



on both sides there and a yardman would go to catch onto it and fall under the engine. Therefore I say the grab-iron should be entirely independent of the uncoupling lever.

MR. TURNER:—Mr. President, there is nothing positive or compulsory, is there, about putting those steps on the pilot? I will say, however, that we use them.

THE PRESIDENT:—The Secretary of the Commission thought it would be, if I understand his interpretation.

MR. TURNER:—On all engines, passenger and freight?

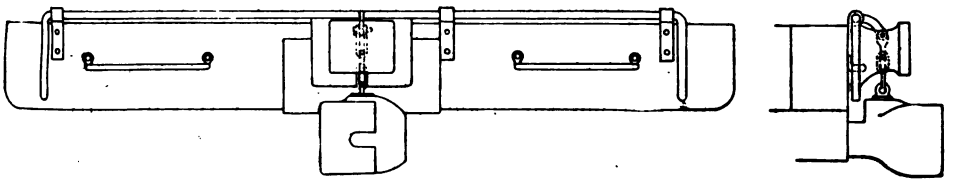
THE PRESIDENT:—Wasn't that it, Mr. Williams?

MR. WILLIAMS:—No; the step is not compulsory, although we thought it would be a good thing as did the committee of the Master Mechanics' Association.

MR. MACKENZIE:—I would like to ask the committee if the practice of the Northwestern Road shows a pilot on the hind end of every engine?

MR. WILLIAMS:—I think that drawing was made from a suburban engine; it has that appearance.

MR. POMEROY:—The Chicago & Northwestern road has a large number of suburban engines with pilots at the front and rear ends.



Rear End of Tender
A.T.&S.F.Ry.

MR. MACKENZIE:—Yes; they have to back all their engines into town, about five or six miles, you know.

MR. TURNER:—There was one more thing. In removing a pilot, an engine is switching, did it say anything about attaching a foot-board to the rear of the tender?

MR. WILLIAMS:—That was not included in the report. The report was to cover the application of uncoupling-rods and grab-irons on the front end of locomotives and the rear end of tenders on road engines. Switching engines were not considered, as they are always fitted with special designed safety appliances.

THE PRESIDENT:—We have two other reports, gentlemen. We do not want to cut off this discussion until everyone has spoken who wishes, but we want to make haste. If no one else cares to speak we will declare the discussion closed.

MR. MOONEY:—I move this discussion be closed and be opened again at our next regular meeting. Carried.

THE SECRETARY:—Mr. President, that completes our regular schedule of special papers. We have two other reports in answer to questions in the Question-Box. The first of these is by Mr. Thompson on "Apprentices in Shops.

APPRENTICES IN SHOPS.

OSWEGO, N. Y., October 28, 1903.

To the President and Members of the Central Railway Club:

GENTLEMEN:—Tons of useful and instructive literature on the subject assigned to the writer have been written by men eminent in the motive and car departments in this country, and little of anything interesting can be added, particularly by one of my limited experience. Were it not that I am at liberty to quote very liberally from a very interesting and instructive letter on this subject from Mr. G. M. Basford, Editor of the *American Engineer and Railroad Journal*, who has no doubt given the subject of "Apprentices in our Railroad Shops" more thorough and careful study than any man in the country, my efforts would be weak indeed.

When reading the letter from our Secretary, notifying me that the President had appointed me to prepare an answer to the following question, *i.e.*. "What is the best method to induce Apprentices to go and stay in the Boiler and Blacksmith Shops?" the thought occurred to me, "Why specify any particular shop?"

During the past year the writer has been requested to assist some of his friends in finding suitable foremen for the different trades in our shops.

Six different superintendents of motive power and master mechanics, representing approximately 10,000 mechanics, were applied to, and in each and every case the same reply was received, *i.e.*, "Regret to advise that we cannot accommodate you, but we are in need of some good foremen ourselves."

Gentlemen, the time is here when we should not only ask the question, but act in a way that will give us apprentices in our shops

and boys who will be a credit to us, as our future foremen, master mechanics and superintendents of motive power.

The average American boy, of whom we are all proud, has considerable human nature in his make-up, and after entering our shops, at a salary that is not sufficient to take his girl to the circus and buy peanuts, all in the same evening, it does not take him long to see that the helper who does not know as much as the boy, after he has served three months, is getting enough to make him a comfortable living, and that if the helper shows himself a little proficient in some certain part of the business, he is paid a full fledged mechanic's pay in a year or two.

He also sees the special apprentice taken in and given the best of opportunities to improve himself. He also notices that it has been the policy of the railroads to better the condition of every one in financial and other ways, from the president to and including the "Dagos" on the section, with the exception of the apprentice. He also notices that he is looked on with disfavor by a good many mechanics and barely tolerated by the different sub-foremen; seldom noticed by the general foreman; and in a good many cases, the division officer or superintendent of motive power is farther away from him than the North Star.

Under such circumstances, is it any wonder that our boys get discouraged and with opportunities of easier and nicer work with so much more remuneration, and in a good many cases, surer and better promotion rewarding their efforts?

It should be no wonder to us that our bright and intelligent boys will not stay in the shops, and that in the majority of cases, where they do stay because they are under moral obligation to do so, they are turned out careless and inefficient mechanics.

In looking around for some information on this subject, I received a letter from a well-known master mechanic which is very pertinent and is as follows:

"Referring to your letter of the 8th inst., I do not know of any method whereby apprentices could be induced to stay in the boiler and blacksmith shops. There is only one thing that compares favorably with the apprenticeship system in the shops under existing conditions, and that is about four years in the Joliet penitentiary or two and one-half years in the Kankakee insane asylum; and to my mind the only way we can be sure to keep apprentices until they serve their full time is to cajole them into the shop, then chain them to a post and bring their meals to them."

While such heroic measures would be out of place there is a good deal of homely truth in the letter.

In my opinion the best method to induce apprentices is, not to work in the blacksmith and boiler shop, but consider the apprentice system as a whole. While it is easier to keep a boy in the machine shop for the simple reason that the work is a little more pleasant,

under the present system, he is working under the same difficulties heretofore enumerated.

What is needed is a complete change of heart and methods in regard to the apprentice. Instead of considering them as apprentices we should look at it in the same light as we do in turning out more work every year for a given amount of money. The pace should be set by the highest division officer, and he should consider the welfare of his apprentices his paramount duty, and in that way create the opportunity of filling his shop with men fully prepared to successfully cope with their chosen profession. This means that you can, if you will, have a number of good mechanics available every year to keep your ranks full, and if you conduct your shop in a way to make the service attractive and interesting to them, there will be no trouble in keeping them.

This looks like an arduous task, but as the large part of your work is training the general foreman, it can be done without serious inconvenience.

The first point is that every department in the shop should have its apprentices.

Second.—Apprentices' wages are altogether too low. Instead of compelling the boy to work one year for five or six cents per hour, he should work only six months for that pay. The next year his wages should not be less than one dollar per day.

The next year he should be paid nearly as much as the ordinary helper; the next year and the last six months of the fourth year, he should be paid as much as the ordinary and special helpers, respectively.

This looks like and is a radical departure from existing methods, and while you are giving the boys the benefits of a training, and it can well be argued that their instruction represents wages; yet, with proper training and instruction, they can and will do better and a great deal more intelligent work than the ordinary helper, so that this feature should certainly receive consideration in connection with their remuneration.

Third.—It is of the utmost importance that very careful consideration be given to the critical period of a boy's life, *i. e.*, at the time of the completion of his apprenticeship.

The practice which exists in a good many shops of discharging an apprentice when his time is out is decidedly wrong. It, of course, is done to let the graduate down and out easily should he prove to be an undesirable candidate for such positions in the shop as graduated apprentices can fill. The eminently proper time to get rid of undesirable apprentices is the first six months or a year at the latest, and in that way give the boy a chance to enter into some other path of life to which he will be better adapted, and rid the mechanical world of some of the barnacles of which there is now altogether too many.

APPRENTICES IN SHOPS.

The greatest care should be exercised in the selection of apprentices. They should have at least a good, common school education, of known good habits. Sons of employés should be given the preference and they should be of good bodily health, and between 17 and 20 years of age.

Fourth.—Under existing conditions there is a great and growing tendency for apprentices to become tramps and every legitimate effort should be made to offset this. The old saying, "To keep the children at home, you must make it attractive for them or they will seek pleasure elsewhere", applies here.

A good many boys wish to go to other shops for the experience to be gained, which, we will have to admit, has its laudable features; but when they do try to get them to go to other shops on your system, and in that way let your company get the benefit of the training you gave them. I am firmly of the opinion that if the foreman, master mechanic or superintendent of motive power have done their full duty while training the boy, and show a little active interest in his welfare by writing him an occasional letter, it will be but a matter of a short time when your boy will come back to you and come to stay and will be a better man for you by the experience gained while travelling around.

Fifth.—Satisfactory results cannot be obtained in any apprentice system without the proper interest being taken by the foremen to properly train an apprentice. They must be broad guaged enough to understand that in this day of specialities the apprentice is the coming foreman, master mechanic and superintendent of motive power, and in their dealings with the boys should conduct themselves so they will be considered by the apprentices as ideal men, and invite them to aspire to be able to take and hold their foreman's positions in after years.

This looks like a hard thing to do and it takes lots of a foreman's time and requires patience, but the results are more than gratifying and they are amply repaid in the satisfaction there is experienced and the reputation gained by turning out good mechanics.

Sixth.—The most vital part in the training of apprentices is the selection of mechanics as the instructors of them. It is a well known fact that the man the boy works with will either make him a slow, inefficient workman or an honest, conscientious one. The boy naturally looks up to the man he works with and almost invariably follows in the man's footsteps, and it is absolutely necessary that none but the best mechanics, both morally and intelligently, be allowed to be the educators of our boys.

Seventh.—In these strenuous times it is not possible to obtain even medium results with boys without developing them outside the shops; and to obtain results that will be of lasting benefit to the boys and

railroad companies as well, an apprentice club or association where boys who have not been fortunate to have been given a technical education can secure information on a variety of subjects that will put them on an equality with their more fortunate brothers, and with a little interest taken by those in charge and the expenditure of a trifling amount of money, the most satisfactory results can be obtained and the disposition a boy shows to benefit by the opportunities given him will show before his first year is completed whether he is in the right business or not.

A good comfortable room should be provided and also an evening draughting school with compulsory attendance. The boys should be encouraged to assemble, and ideas entirely outside of their ordinary experience should be placed before them.

In every shop there are men who will and can give informal talks on matters interesting to boys who are seeking information, and it gives a splendid opportunity for foremen, master mechanics, draughtsmen and even the superintendent of motive power to give the boys an occasional heart to heart talk, which will encourage them and awaken an interest and ambition and go a long way towards building up the character which is so much desired in the mechanic of to-day. We can take it to ourselves, if you please. All of us feel better and stronger and more able to successfully cope with life's battles after receiving a hearty word of encouragement from our superiors.

Eighth.—No apprentice system that can be devised will ever be a success unless every one, from the highest official to the mechanic entrusted with the education of the boy, appreciates the responsibility connected with starting an apprentice in and training him right. The apprentice must know the foreman, they must know the higher subordinate official and to as great extent as possible the chief officials of the departments in which they work.

We all point with pride to our special apprentiee boys who have had the advantage of a technical training. We spend our company's money to re-educate them to the practical side of railroad life and as far as my observation goes makes me believe that the same amount of money spent and the same pains taken in the way of giving the ordinary apprentice a chance for self-education, suitable for shop apprentices, we will get better mechanics, more capable foremen and officers in higher positions than can be obtained in any other way, and in conclusion will earnestly urge you to give our apprentice boy a chance to live while you are educating him, make it a hard and fast rule with severe penalties attached for failure to strictly observe that it must be everyone's business in authority to look after the apprentice and you and the companies you represent will be the chief gainer by it.

Yours very truly,

W. O. THOMPSON.

THE PRESIDENT:—The subject is open for discussion.

MR. MOONEY:—As this is a very important paper, Mr. President, I move it be printed in the proceedings and discussed at a future meeting. Carried.

COURTESIES ACKNOWLEDGED.

Mr. Mooney offered the following resolution which was adopted:

RESOLVED that the thanks of the Central Railway Club are due and are hereby tendered to the Lackawanna Steel Co. for the privilege and courtesy extended to members of the Club at the September meeting whereby they were permitted to make a tour of the great steel plant that the company has established near Buffalo. Although the visit made was necessarily brief it was sufficient to impress us with the magnitude, completeness and comprehensiveness of the establishment. It also prompted congratulations to the people of Buffalo upon the spirit of progressiveness and liberality which led to this splendid addition to the city's manufacturing industries. We recognize that it will strengthen and enhance Buffalo's proud position as an important manufacturing center and will serve to hasten the day when, in that regard, it will be the peer of any other city equally devoted to industrial activity, and a realization of the ambition of its people in that respect.

THE SECRETARY:—If there is no objection I think it would be very proper at this time also to authorize the Secretary to make proper acknowledgment to the Natural Food Co. for the repetition of the courtesy which enables us to meet in this beautiful hall again to-day.

MR. MOONEY:—I so offer that as a resolution. Adopted.

QUESTION-BOX QUERIES.

BUFFALO, N. Y., October 25, 1903.

To the Officers and Members of the Central Railway Club.

GENTLEMEN:—As a committee of one to make a reply to the following: "What is the amount of water necessary to haul 100,000 tons of freight 100 miles?" I beg to say that this is rather hard to estimate because there are so many varying conditions, such as head winds, slippery rail, grade of the track, class and condition of the

engine and steam pressure carried, and how the engine is worked, etc.

But, considering the grade to be about level, with a simple engine in fair condition and properly worked, would say that about 7,500 gallons would be evaporated per mile, or 750,000 gallons for 100 miles.

Yours truly,

WM. OWENS.

MR. OWENS:—Mr. President and members, I think I owe you an apology for not going into that a little deeper than I did, but I have been very busy during the last month or two and I took as a basis some tests made some three or four years ago with a 20x26 cylinder and 55-inch wheel on a level grade. Now we consumed about 3,000 gallons to haul 2,000 tons 20 miles. If that were figured out theoretically by draw-bar pull and size of cylinder, I dare say it would be somewhat less.

MR. THOMPSON:—Mr. President, the gentleman who was going to answer the third question in the Question-Box, something about—

THE SECRETARY:—Mr. Hogan should have answered it.

MR. THOMPSON:—Mr. President, the gentleman assigned to the third question asked in the Question-Box, is Mr. C. H. Hogan. He wishes me to inform you that he would not be able to present his paper at this meeting, on account of the weather being so mild that he was unable to make the necessary tests on their steam heated trains to get the necessary information.

DEATHS OF OLD MEMBERS

THE SECRETARY:—I regret to announce, Mr. President, that since the subject of loss of members by death was up before, I have been advised of the death of Mr. R. Donaby, foreman car repairs of the New York Central, at Niagara Falls, who died very suddenly a few days ago in his office. He was one of our oldest members. The Secretary would take the liberty of suggesting to the Chair the appointment of Mr. Macbeth, Mr. Sills and Mr. Rhodes; the two latter, I think, have been associated more or less with the late Mr. Donaby; as a committee to frame suitable resolutions on the subject.

THE PRESIDENT:—That committee will stand.

THE SECRETARY:—Death has also deprived us of another of our oldest members—Thomas Anderson, Manager of the Youngstown Car Company. He died October 17.

THE PRESIDENT:—Any member anything to offer for the good of the club?

MR. MOONEY:—Mr. President, before adjourning I would like to ask permission of the club to amend my motion in reference to Mr. Jones' resolution. It appears to me that quite a number of the members here did not really understand the sense of the resolution when it was offered. Personally I find an underlying reason for offering this resolution. Inasmuch as in all the railroad clubs of this country, the Master Mechanics Association and the Master Car Builders, the executive committee always appoints the secretary of the club or association, I consider it a reflection on the executive committee of this club to offer any such resolution here. I now move to amend my previous motion so that it will read that the resolution be laid on the table indefinitely.

MR. POMEROY:—I second the motion, Mr. President. You know it took a number of years to get through the Master Mechanics' convention a change in the by-laws, corresponding to the practice followed by the Master Car Builders' Association to remove from the floor of the convention the embarassment and time of voting for the only salaried office within the gift of the Associations. Inasmuch as the Secretary is the clerk of the executive committee it seems that this committee should have the right to select its own clerk. This is now the practice of nearly if not all the railway clubs, and a departure therefrom would be a retrograde movement.

THE PRESIDENT:—I want to say also in the interest of harmony that we have had enough dissension in this club and we have been trying for the past year to cement the members together on one solid basis, and think this would be the means of creating disorder, and heartily approve of Mr. Mooney's suggestion and resolution and will

be glad to offer the amendment. The amendment now is that it be laid on the table indefinitely. Carried.

THE SECRETARY:—I would like to have the President impress upon our members the value of the Question-Box as already demonstrated.

THE PRESIDENT:—I want to say also that I am more than glad to have this discussion to-day. Prof. Goss has attended many of our New York Railway Club meetings and seen a much larger number in the meetings, but I am sure he has never heard the papers or subjects discussed to any more advantage than here to-day.

PROF. GOSS:—That is correct, Mr. President.

THE PRESIDENT:—And I am glad, on the Professor's account and on my own account, and feel that every man present is glad that he is here to-day. The motion to adjourn is now in order.

Adjourned.

THE NEXT MEETING.

The next meeting of the Central Railway Club will be held at the Hotel Iroquois on Friday, January 8, 1904, at 2 P. M. This being the annual meeting officers will be elected for the ensuing year. The Executive Committee is requested to meet at the same place at 1 P. M.

GAS AND GASOLINE ENGINES.

Prof. William T. Magruder of the Ohio State University, will read a paper on "Gas and Gasoline Engines in Railroad Work."

PNEUMATIC TOOLS IN RAILROAD WORK.

Another special paper to be contributed by the Chicago Pneumatic Tool Co., will deal with "Pneumatic Tools in Railroad Work."

UNFINISHED BUSINESS.

Discussion will be continued on the paper presented at the

November meeting by Prof. W. F. M. Goss on "Locomotive Front-Ends," that of Mr. W. O. Thompson on "Apprentices in Railroad Shops" and the report of the special committee on the "Safety Appliance Law."

THE QUESTION-BOX.

Mr. Charles H. Hogan, Master Mechanic of the New York Central, is to present a reply to the inquiry: "Why, when steam heat gauge on engine shows 75 or 80 pounds pressure, in many cases gauges in cars in train will not show anything?"

Members who can not attend the meeting or are reluctant to express their opinion orally, are requested to send their views upon the subjects here scheduled, in writing, to the Secretary.

CLUB ENTERTAINMENT.

The Committee on Entertainment had not completed their arrangements when the printed Proceedings were issued and this part of the programme for the day will be announced when the usual official call for the meeting is sent out.

Harry D. Vought

Secretary.

BACK NUMBERS OF PROCEEDINGS WANTED.

Copies of the following issues of the Central Railway Club's Proceedings are wanted and may be sent to the Secretary:

March, 1894.	September, 1901.
March, 1896.	September, 1902.
March, 1897.	May, 1902.
November, 1899.	May, 1903.

Subjects Discussed by Other Clubs.

1903 — New York Railroad Club.

November 20

"Safety devices for Locomotive Front-ends."

"Is there a Really Adjustable and Reliable Staybolt for Locomotive Boilers?"

"Draft gear for passenger cars: what are the particular parts that show, by the amount of repairs, that they are weak and should be strengthened, reference being made to tail of coupler, the yoke, the pin connecting the yoke to the coupler tail, springs, check plates or pockets, buffers and any other parts, which have received particular attention, and which have given indications of being too weak for the service."

December 18

"Design and Operation of Division and Tide Water Terminals," by C. L. BARDO.

New England Railroad Club.

October 12

"Steel castings in locomotive design," by H. B. AYERS.

"Locomotive Front Ends," by WALTER B. LEACH.

"The True Economy of Painting of Locomotives," by A. P. DANE.

November 10

"Counterbalancing Locomotives," with paper by R. A. PARKE, of the Westinghouse Air Brake Company.

St. Louis Railway Club.

October 9

"Terminal Necessities," by W. M. PRALL, of the Central Car Service Association.

"Proposed Improvements in St. Louis Terminals," by A. P. GREENSFELDER.

November 13

"Car Damage, Past, Present and Future; Its Cause and Prevention," by CHARLES WAUGHOP, Chief Joint Car Inspector.

Railway Club of Pittsburg.

November 27

"The Essentials of a Modern Railway Paint Shop," by W. O. QUEST, master painter, P. & L. E. R. R.

North-West Railway Club.

October 15

"Passenger Car Heating," by Mr. R. P. BLAKE, Mechanical Engineer, Northern Pacific Railway.

December 15

"Draft in Ash Pans," by S. SHEPARD.

"M. C. B. Coupler Limit of Wear Gauge," by MESSRS. MOORE, BAYLESS and BARBER.

"Bad Order Cars," by W. A. PARKER.

M. C. B. Rule No. 64: "No wheels to be applied to foreign cars that the dates cast show them to be over six years old."

Canadian Railway Club.

October 6

"Maintenance and System of Keeping Check of Repairs to and General Condition of the Air Brakes under Freight Cars," by W. C. HUNTER, General Air Brake Inspector Intercolonial Railway.

November 3

Discussion continued on "Maintenance and System of Keeping Check of Repairs to and General Condition of the Air Brakes under Freight Cars."

"Hardening and Tempering of Steel," by PROF. ALFRED STANFIELD, of McGill University.

Iowa Railway Club.

October 20

"Operation of the Per Diem Basis of Car Hire," by F. A. DELANO, General Manager, Chicago, Burlington & Quincy Ry.

"Magnetism Applied to Traction," by H. F. BROWN, Magnetic Equipment Co., of Chicago.

"Automatic Lock for Air Brake Equipment on Passenger Trains," by JNO. FRIDGEN, Chicago Great Western Railway.

"Should Frogs and Switches be Blocked?" by J. L. DAWSON, Chicago, Burlington & Quincy Railway, and J. HARRINGTON, Chicago & Northwestern Railway.

"The Proper Position of Side Bearing," by GEO. H. BROWN, Master Mechanic, Milwaukee & St. Paul Railway, Chicago.

Richmond Railway Club.

November 12

"Some Experiments with Exhaust Pipes," by T. H. SYMINGTON.

"Railway Car Lighting," by JOHN KIRBY, JR.

R. DONABY,
DIED 1903.

D. W. JACKSON,
DIED OCTOBER 13, 1903.

THOMAS ANDERSON,
DIED OCTOBER 17, 1903.

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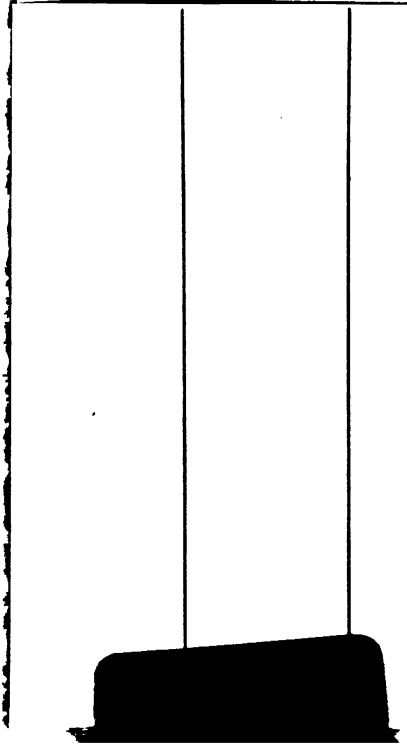
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